THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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TO "ELECTRICAL REVIEW" READERS.

Owing to the continued increase in the circulation of the ELECTRICAL REVIEW in recent months, an increase which has become accelerated since the signing of the Armistice, we cannot guarantee that casual copies will be available. The only way to make sure of securing a copy regularly as issued, is to place a definite order with a newsagent, or else to subscribe direct to the Publisher, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

CHRISTMAS—AT PEACE.

BEFORE our next issue makes its appearance the Christmas Festival of nineteen-eighteen will have been celebrated. Five years have passed away since this world was privileged to spend its Yuletide amid circumstances suggesting that there was Peace on Earth. Even then the nations, save ourselves and our trans-Atlantic cousins, were armed to the teeth. And now, after the agony and loss of long years of war, we are—if not actually at Peace again, approaching it.

Each Christmas during the war has revived in our ears the message of that company of angels of nigh two thousand years ago. At times it seemed as though the echo of that message was the marching of new armies and the thundering of thousands of guns. Could it be that these were the means of bringing in those peaceful days of which the angels sang? So has it proved to be, and now the carols of a new Christmas sound sweeter far than those of Christmases long since enjoyed—for by reason of these latter years of suffering, distress, and gnawing anxiety, we have been brought out of the period of darkness and death, with victory so definite for the cause of Righteousness, that we are nearer to the era of International Amity than for generations past. We have been fighting to bring to an end all war between the nations, and we have arrived at a stage where the skilful negotiations of Peace plenipotentiaries will reveal and test the sincerity of such a determination, and will, to a large extent, decide whether, or how far, it lies within human power to ensure the attainment of so great an end. In God's name we hope such an issue may be found possible as will save our children from the works of those who delight in insensate destruction, but, high as our hopes may rise, how blind we should be if we ignored the signs that there has been no magic change wrought in the heart of humankind. If the crushing out of the spirit of proud and barbarous militarism meant the uprooting of all human hate we might indulge in optimistic visions of millennial days, but do the evidences of the moment within this and other lands not shake our confidence and counsel walking warily? We have won what we fought for internationally, and in celebrating that grand result this Christmas time, what we need more than we ever did before is an imparting of the true Christmas spirit in the relations between man and man within the nation. We have all borne sacrifices for a Common Cause against a foe without: now we must all bear sacrifices, practise self-abnegation, join interests harmoniously, for the Common Good within.

A hundred thousand men are travelling homeward by various routes to settle down to peaceful avocations. Round many a fireside, as unrationed flames leap upward, there will swell again the happy laughter of the re-united circle, checked betimes by sacred memory and by rising tear. "Over there" millions of men still stand at the post of duty, but neither for them nor for theirs at home will the hardness or the uncertainty be the same as at other war-time Christmases. Over here, for the first holiday season for a long time past the war-works may stand idle, for munition workers' holidays, it is announced, are permissible everywhere. There is anxiety in many minds, it is true, because the end of the war brings expectation of unemployment, but a generous State in recognition of their war-time service has provided for unemployment insurance

giving them time to transfer or to look around. Probably some of the great factories which are changing over to Peace production will not be so silent as is imagined, owing to the holiday week being availed of to get ready for altered operations. The hospitals at home and abroad are still occupied by sick and wounded men who cannot get back to the family circle, and there are amongst us many thousands of Colonials and Americans for all of whom, no doubt, we shall have a place in our hearts.

For all of us, however, it will be the Christmas of the Armistice preceding the Great Peace; and the freedom from strain, the opportunity for rest, the occasion for fraternising, should afford such a season as has never in living memory been spent.

Immense—almost overwhelming—are the tasks that lie awaiting us in the days that follow. Let this respite be so employed as to prepare us the better for those responsibilities, and for their fulfilment in the spirit which marks the season of the coming of the greatest message that was ever brought to our Humanity.

The I.M.E.A.'s Proceedings.

Whilst going to press last week, we received a copy of the Report on National Electricity Supply which was adopted at the general meeting of the Incorporated Municipal Electrical Association last month, and an abstract of the Report appeared in our last issue. It will have been noticed that it consists mainly of qualified endorsements of the conclusions arrived at by the Committee of the Board of Trade, mingled with explanatory comments, which seem somewhat superfluous; of what use, for instance, is it to inform the Committee that the 16 districts are not 16 power stations? Or to explain to the Committee that its report does not contemplate the shutting-down of all existing power stations? When all such redundancies are cleared away, together with the expressions of approbation, there is very little left in the way of criticism or suggested amendment. Perhaps the most notable proposition is that which demands the complete exclusion of the representatives of companies from the District Boards—a remarkable proposal, which seems to have been prompted by the memorandum of some of the North-Eastern Municipalities, upon which we recently commented. Seeing that the companies, which conduct one-third of the industry of electricity supply, are endowed with statutory powers to carry on their business, and are, therefore, recognised by Parliament as public service corporations, it is difficult to understand why they should thus be deprived of a voice in the control of the industry, while large consumers are to be admitted to representation on the District Boards. Is it fully realised that the companies' undertakings are owned by shareholders, who are in some cases very numerous, and have risked their own capital in the business, while the ratepayers and large consumers who are to be put in authority over them have not done so? We do not see how this demand can be reconciled with the principles of British justice. Most of the other suggestions are echoes of the I.M.E.A. meeting of June last, and therefore lack novelty. While we regard the Report of the Association as, on the whole, a weak production, reflecting little credit on its authors, we are glad to see that, at any rate, with the exception above noted, it is not contaminated with the reactionary spirit which pervaded the memorandum of the N.E. Counties; on the contrary, it cordially recognises the merits of the proposals contained in the Board of Trade Report, and endorses the broad principles upon which it was based.

We have so often commended the Council of the I.M.E.A. in the past for wise and well-balanced judgment that we may justly claim the right to criticise its errors, and it is with regret that we must thus characterise its recent actions in connection with the granting of sanctions for extensions—first, in bringing a comprehensive charge against the Ministry of Munitions without due deliberation—a charge which was distributed broadcast to all members of Parliament, and, secondly, when withdrawing the charge, in shabbily throwing the onus of its action upon one of its own members. The Council has given an exhibition of impulsiveness and instability which is not a pleasing spectacle, and will certainly not add to its prestige.

Trade Union Autocracy.

The decision of the controllers of the Union of Licensed Vehicle Workers to withdraw all public road vehicles from service in London after 4 o'clock on Christmas Day will be received with dismay by the many holiday-makers who rely upon such conveyances for the means of visiting their friends on this great national festival—the first "Peace Christmas" for five long years. We do not grudge the workers their share of the holiday, if they prefer to seek their own pleasure rather than to remain on duty and thus to minister to the happiness of hundreds of thousands of their fellows. Those who will suffer most will obviously be the less well-to-do, but all classes will share more or less in the inconvenience that will be inflicted on the public by the action of the Union autocrats. In point of fact, of course, the workers themselves are not responsible for the high-handed action of their leaders; arrangements had already been made for voluntary service on Christmas Day, which would have provided acceptable compensation for those who chose to remain on duty, whilst enabling others to participate in the celebration of the festival. The withdrawal of the services, therefore, is not necessary to this end; apparently it is merely a demonstration of the autocratic powers of the Union leaders. But Nemesis awaits the Union which arouses the wrath of the public; that great silent body may accept the situation with indulgent good humour—but when it is stirred to action, no Union can prevail against it; public opinion is a certain winner, as some of our quondam strike leaders have learnt from bitter experience.

The Times, commenting on this subject, recalls the downfall of Mr. Burns under such circumstances, and remarks that "many other leaders—or misleaders—have had a similar experience; and many more will learn the lesson in their time. There are signs that sundry Unions, intoxicated by facile successes, are being led on to dangerous experiments in high-handed action against the public. An instance was reported yesterday. The secretary of the Electrical Engineers' Union was said to have stated that the supply of electricity would be cut off from London if German prisoners were not removed from a certain farm within 14 days. That is to say, this Union will deprive London of light, power, and traction if the Government do not obey its orders in a matter with which the Union has nothing whatever to do. Obviously the same threat may be applied to any arbitrary purpose whatever, and if it succeeded, London would be at the mercy of an irresponsible dictator. But the inhabitants are a little tougher than that. The Germans thought they could frighten London into forcing the Government to surrender. They were mistaken, and the attempt recoiled on themselves. So will it be with anyone else who attempts to intimidate the public of London."

We entirely agree with this view, but are glad to learn that the alleged threat of the Electrical Trades Union was entirely unauthorised, and is repudiated by the secretary of the London Branch.

Whilst going to press we learn also that the Vehicle Workers' Union has agreed to recommend its members to volunteer to run a number of omnibuses on Christmas evening, but apparently there will only be a very few, and the tramways will be idle altogether, so that the inconvenience to the public will be very serious. Similar conditions are reported from provincial centres, in many of which the transport services will be at a standstill; but the effect will be felt most severely in London, owing to the greater distances to be traversed in our over-grown Metropolis.

THE ELECTRIC TRACTION RETURN CIRCUIT.

By A. JOHNSTON, A.M.I.E.E.

In direct-current traction systems the length and size of the feeders are usually determined by the fall in voltage allowable.

On the positive side of the system, a loss of 10 per cent. in the voltage is frequently considered as being the maximum which should be permitted for satisfactory working, while the Board of Trade has fixed 7 volts as the maximum drop in potential which should take place between any two points on the rails.

There is no great difficulty in keeping within any reasonably prescribed limit on the positive side without undue expense, it only being necessary to correctly proportion the resistance of the feeders to the current; but on the negative side, when the traffic is heavy or the route is long, considerable trouble is frequently experienced, and several methods are adopted by engineers to surmount it.

It is usually less costly to increase the weight of the rails, if that would be sufficient to reduce the fall in potential to within the limit without the rails becoming too unwieldy; but where it is not sufficient, one of the following supplementary expedients is employed:—

An uninsulated copper conductor is laid between the rails, and is bonded to them, for a certain distance from the point of supply.

An insulated conductor is connected to the rails at one point only, which is some distance from the point of supply, and the other end is connected to the negative terminal in the supply station.

An insulated conductor is connected, as in the previous case, to the rails at a distant point, but the other end is conveyed to the negative terminal of a small auxiliary generator or "negative booster."

The field magnets of the negative booster are excited, either by being connected in series with the positive feeder which feeds the section nearest the point where the negative feeder is connected to the rails, or alternatively, the machine is a simple series generator placed in series with the negative feeder. The former method has the disadvantage that the current in any single positive feeder is seldom proportional to the fall of potential at the boosted point, since frequently the current from other feeders returns by the same rails.

To examine these methods of dealing with the problem a hypothetical single section of tramway will be considered the length of which from the terminus to the point of supply is X miles, over which a regular service of cars is run requiring a amperes per mile, the current being assumed to increase regularly from zero at the terminus, to xa amperes at any point x miles from the terminus instead of increasing in steps at each car, this way of dealing with the subject being convenient for general calculations, though not quite so accurate as the former method when reliable data are available. The resistance of the rails per mile is r ohms over the whole route. As a numerical example, and in the curves, the following values are taken:—The length of the route is six miles, which is laid with a double set of rails weighing 85 lb. per yard, the four of which bonded together would have a resistance of about ·016 ohm per mile. A service of single cars is run at intervals of six minutes in each direction, the average current per car being 20 amperes and the average speed eight miles per hour. Thus—

$$X = 6,\ r = \cdot016, \text{ and } a = 32.$$

In order to provide for abnormal conditions the maximum permissible difference in potential between any two points on the rails is taken as 5 volts = V.

If the rails alone are used as the return conductor it is evident that—

$$dv/dx = -arx, \text{ and } V = M - \tfrac{1}{2}arx^2,$$

in which the value of M will depend on whether the potential of the rails is considered to be zero at the terminus or at the point of supply. Assuming it to be so at the latter place, then $M = \frac{1}{2}arX^2$, so that the potential at any point x, $V = \frac{1}{2}ar(X^2 - x^2)$, and at the terminus where $x = 0$,

$$V = \tfrac{1}{2}arX^2 \quad \ldots \quad \ldots \quad (1)$$

which formula is applicable to any simple section of electric tramway or railway; the curves in fig. 1 show the values of V and the current through the rails at any point x along the route.

If the rails are assisted by an uninsulated conductor bonded to them at frequent intervals, running either the whole length of the route or part of it nearer the point of supply where the current density is greatest, it will be equivalent to reducing the rail resistance to, say, R ohms per mile.

If this conductor starts at $x = Y$ its length will be $X - Y$, and the voltage curve from Y to X will be $v = \frac{1}{2}aRX^2 - \frac{1}{2}aRx^2$, and treating the section to Y by itself,

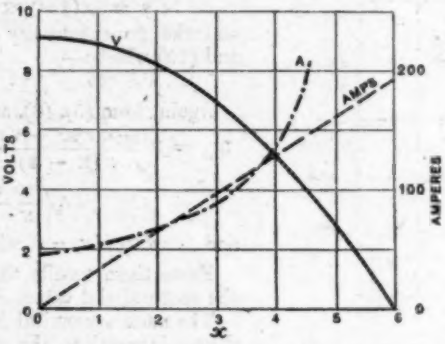

Fig. 1.—Voltage Curves, Rails alone.

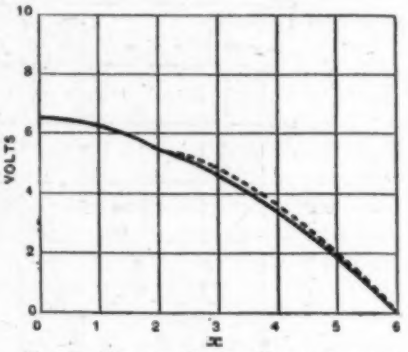

Fig. 2.—Voltage Curves, Rails assisted.

the voltage at any point $= v = \frac{1}{2}arY^2 - \frac{1}{2}arx^2$, so that the voltage at the point $x = 0$ will be—

$$V = \int_Y^X -aRx\,dx + \int_0^Y -arx\,dx,$$

from which—

$$V = \tfrac{1}{2}aRX^2 + \tfrac{1}{2}arY^2 - \tfrac{1}{2}aRY^2 \ldots. \quad (2)$$

The full-line curve in fig. 2 shows V in this case, in which the resistance per mile of the uninsulated conductor is assumed to be ·032 ohm.

If the resistance of the supplementary conductor in (2) is t ohms per mile, then $(r + t)R = rt$, and rejecting R from (2) it will be found that—

$$t = (Vr - \tfrac{1}{2}ar^2Y^2)/(\tfrac{1}{2}arX^2 - V). \ldots \quad (3)$$

When an insulated conductor is laid from Y to X to assist the rails, no booster being used, and the current A returning through the negative feeder is less than aY, then V will be the sum of—

$v_1 = \frac{1}{2}arY^2$, the fall over the section to Y,
$v_2 = (aY - A)(X - Y)r$, the fall over the section $(X - Y)$ due to the current $(aY - A)$, and
$v_3 = \frac{1}{2}ar(X - Y)^2$, the fall over the section $(X - Y)$ due to the current received between X and Y.

Hence $V = \frac{1}{2}arX^2 - rA(X - Y)$. ... (4)

The final voltage at the terminus, when an insulated negative conductor is used, is the same as when the conductor is uninsulated, assuming the same sectional area in

both, but the voltage curve, shown dotted in fig. 2, is somewhat higher between Y and X.

If a booster is employed, and the current A is greater than aY, it is evident that the current passing through the rails will be zero at some point between X and Y. Let that point be m miles from the terminus; then it is clear that $m = A/a$ and that V may be considered to be the sum of three simple sections, viz. :—

$v_a = \frac{1}{2} ar\,(X - A/a)^2$ from m to the supply point;
$v_b = \frac{1}{2} - ar\,(A/a - Y)^2$ from m to Y; and
$v_c = \frac{1}{2} ar\,Y^2$ from Y to the terminus.

From which $V = (4)$, which is therefore true whether A is greater or less than aY.

From (4) it is clear that the current which must be abstracted from the rails at the point Y is—

$$A = (\tfrac{1}{2} a r X^2 - V)/r\,(X - Y), \quad \ldots \quad (5)$$

and the problem, therefore, is the best means of removing this current, which is plotted with regard to Y in fig. 1.

If the resistance of the insulated negative feeder is s ohms per mile, then the current which will return by it, without a booster, will be due to the difference in potential between X and Y, which is—

$$v = \tfrac{1}{2} a r\,(X^2 - Y^2) - C r\,(X - Y),$$

and the resistance of the feeder is $s\,(X - Y)$,—
so that $C = \frac{1}{2} a r\,(X + Y)/(s + r)$;
substituting this value for A in (4),—

$$V = (\tfrac{1}{2} a r X^2 - \tfrac{1}{2} a r^2)\,(X^2 - Y^2)/(s + r). \quad (6)$$

From (6) $s = t$ in (3) showing that there is no advantage in insulating a negative feeder when laid parallel to the track if no negative booster is used, though in practice it

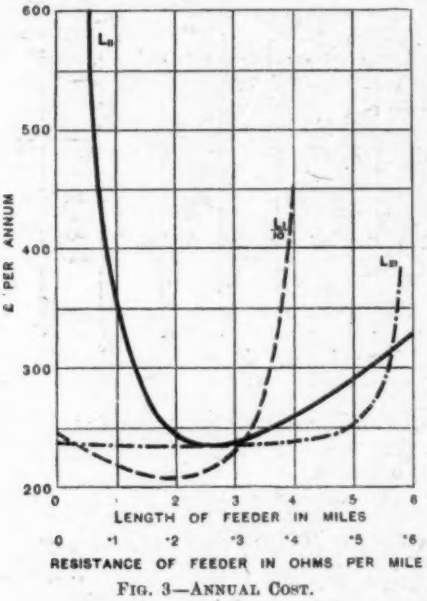

Fig. 3—Annual Cost.

is seldom possible to predict events and conditions with any exactitude, and it is, therefore, advisable in nearly all cases to lay an insulated cable for this purpose, as any increase in Y can be dealt with by the installation of a negative booster.

When a booster is used, it is easily seen that the current which will return by the negative feeder will be—

$$C = \tfrac{1}{2} a r\,(X + Y)/(s + r) + u/(s + r)(X - Y), \quad (7)$$

where u is the effective voltage of the booster, and substituting this value for A in (4)—

$$V = \tfrac{1}{2} arX^2 - \tfrac{1}{2} a r^2(X^2 - Y^2)/(s + r) - r u/(s + r). \quad (8)$$

Comparing (1), (6), and (8), it is seen that the effect of the negative feeder is—

$$B = -\tfrac{1}{2} a r^2\,(X^2 - Y^2)/(s + r),$$

and of the booster alone is $D = -r u (s + r)$, so that if it is found, where an insulated feeder is already installed, that the fall in potential is too high by D volts—that is, $(6) = 5 + D$ without a booster, then the *effective voltage of the booster required* will be $u = -D(s + r)/r$ since $D = -r u/(s + r)$, and the current will be A in (5).

The annual cost of an insulated negative feeder may be taken, with a fair degree of accuracy, to be proportional to its weight. Thus if K is a fraction representing the annual cost of one mile of feeder having a resistance of 1 ohm, then the annual cost of the feeder is represented by—

$K\,(X - Y)/s$, or inserting the value of s in (3)—

$$L_I = K\,(X - Y)/s = (K\,X\,V - \tfrac{1}{2} a r K X^2 - K Y V + \tfrac{1}{2} a r K Y X^2)/(\tfrac{1}{2} a r^2 Y^2 - V r),$$

and by differentiating with regard to Y, the value of Y that will make $d L_I/d Y = 0$, or will make the annual cost a minimum, is—

$$X - Y = \sqrt{X^2 - 2 V/a r}. \quad \ldots \quad (9)$$

Taking K at 1,880 pence, the annual cost, L_I of the insulated negative feeder is shown in fig. 3.

The cost of the booster may, for small machines, be considered as being proportional to its output, and if H is a fraction representing the annual cost per watt, then the total annual cost may be written $H C u$. H must be evaluated by taking all sources of loss and cost into account, such as the interest and depreciation on the capital cost, the overall efficiency, the hours run per annum, the watts taken to run the machine, the value of the energy used, &c.

In the curve $H = 6{\cdot}45$.

Let the annual cost of the booster and negative feeder combined be $L_{II} = H C u + K\,(X - Y)/s$, then from (5) and (8)—

$$L_{II} = H\,(\tfrac{1}{2} a r X^2 - V)(\tfrac{1}{2} a s X^2 + \tfrac{1}{2} a r Y^2 - V - V s/r)/r(X - Y) + K\,(X - Y)/s,$$

and by differentiating L_{II} with regard to s, the value of s that will make $d L_{II}/d s = 0$, or will make L_{II} a minimum is—

$$s = \sqrt{(K/H)}\,(X - Y)\,r/(\tfrac{1}{2} a r X^2 - V), \quad (10)$$

and the current density per sq. in. in the feeder, from (5 and (10) will be—

$$\phi = \sqrt{K}/{\cdot}043\ \sqrt{H}.$$

Again, from (5), (8), and 10)—

$$L_{III} = H\,\frac{(\tfrac{1}{2} a r X^2 - V)}{r\,(X - Y)}\left(\sqrt{\frac{K}{H}}\,(X - Y) + \tfrac{1}{2} a r Y^2 - V\right) + \sqrt{\frac{H}{K}}\,\frac{(\tfrac{1}{2} a r X^2 - V)\,K}{r},$$

and $d L_{III}/d Y = 0$, when $X - Y = \sqrt{X^2 - 2 V/a r}$. (9)

From these results the following rule, independent of the controversial values of H and K, is obtained :—

The most economical length of a traction negative conductor is equal to the square root of [the route length squared, — 10 divided by the product of the amperes per mile into the track resistance per mile].

This rule assumes the limiting potential difference V to be 5 volts.

From (1) the longest length of line which can be worked without assisting the rails is $X = \sqrt{2 V/a r}$ and also the longest line possible with a single booster and feeder is $X = 3\sqrt{2 V/a r}$. In the latter case, according to the rule given, the most economical length of the negative feeder is $X - Y = \sqrt{8}\,\sqrt{2 V/a r}$, but it is evident that two-thirds of the total current sent out to the line must be returned by the feeder and that the length of the feeder must be $2\sqrt{2 V/a r}$, so that the most economical length cannot be used with a line of this length; in fact, the rule is not applicable to any line where $X > \sqrt{5}\,\sqrt{2 V/a r}$.

Examining the curve L_{III} in fig. 3, which shows the annual cost of the booster and feeder, it will be seen that it is almost flat until the value of X—Y becomes too small for practical purposes, and that, therefore, a considerable amount of variation from the correct length will make very little difference in the annual cost, but it must be borne in mind that it is probable that during many hours of each day the feeder alone will be sufficient to keep V down to 5 volts, and by inspecting the curve L_I, the annual cost of a negative feeder alone, it will be seen that a sharp rise takes place fairly near on each side of the correct length. A comparison of L_I and L_{III} emphasises the futility of installing unboosted negative feeders from a financial point of view, it being observed that the curve is shown reduced, in the former case, to one-tenth its value.

THE CONTRACTOR'S APPRENTICE.

By DONALD SMEATON MUNRO.

The new English and Scottish Acts decree that every little Briton must attend school between the ages of 5 and 15, and thereafter be compelled to go to continuation day classes for periods which shall aggregate 320 hours per annum until he, or she, is 18. The obligation to attend a continuation school is not to apply to young persons above 16 who have remained until that age under full-time instruction at an approved school.

The scheme is going to cost the country many millions a year for the maintenance of new schools, colleges, and salaried posts. It is going to involve millions of millions of commercially unproductive hours. Yet if the future mass of our people attains to a more efficient and happier life, and if our nation keeps her topmost place thereby, then surely the money and time will be well spent.

It is too late to argue that England's Shakespeare, or Scotland's Burns were not educational conscripts, and yet did pretty well. The boast of the self-made man will no longer be heard in the land—unless, indeed, he hails from a neighbouring isle where Education Acts will probably not be enforced.

The plan is too big and serious, however, to be joked about. It is a duty to grapple with its somewhat disturbing difficulties and develop the undoubtedly good elements which it contains.

How can we best apply the conditions to meet the case of the aspirant to electrical engineering? There will always be a class which will continue preliminary theoretical training at technical college or university till well on in the twenties. That section will not be affected by the Acts, except, possibly, by having to study longer or harder to keep relatively ahead.

Almost all divisions of the electrical industry require recruits of sound education.

In the reconstructed world we have to displace and far surpass the *Mittel Europa* technically trained man. It is important, therefore, that the bulk of our apprentices should be lads who have remained at school until the age of 16 or 17, and have thereby acquired, at least, the habit of learning. The majority of this class will quite eagerly continue their theoretical studies in the evenings—till well on in their teens.

If a boy displays no aptitude for study whatever, he will probably want to be released from school at the earliest possible age, and in this case even, the end is attained by remaining at full-time classes until he is 16. Probably he himself would prefer to secure complete freedom thus, to the alternative of giving up six hours per week until he was 18. Under the Acts, therefore, it would appear that both the scholar and the dunce would choose to attain liberty at 16. The former would then be free to continue his classes, and the latter to drop them.

It is not quite clear from a first reading of the clauses whether evening classes are, or are not, debarred to youths under 18 who have remained at school until 16. Surely it is not the intention to encourage idle evenings at that most critical age. We do not want to multiply that particular kind of imp we have seen going about in war time with spats and a fag.

Electrical engineering holds a fascination for the foreordained aspirant. If he knows he cannot commence his apprenticeship favourably until he is 16, he will likely work all the harder during his last year at day school, but the scope of the industry is so varied that I would not advocate, as an absolute necessity, that no apprentice be allowed to commence until he is 16.

The type of boy who would nowadays enter a factory at 14 should still be allowed to do so. Every factory will have to pay more attention to the boy's physical and mental training. Of course, many of our manufacturers have long been alive to this, and find that it pays to take interest in their youthful employés. It is to be hoped that the educational authorities will interpret the Acts with some degree of flexibility. It would be a pity if the new arrangement should interfere with some of these excellent schemes which have been proved to work well. Some are so complete that they provide not only for the adolescent stage of training, but carry the youth on to the universities while still keeping up his connection with the works.

In other divisions of the electrical field, it appears impracticable to employ boys in any number who are required to leave their employment for at least 320 hours per annum to attend schools.

In contracting, for instance, the apprentices are scattered all over a town. One day a boy is on a ship and the other perhaps down a mine. Even if the territorial range of his alleged duties is not too extreme, it is obvious that complying with the Acts' requirements is a much more onerous business for the contractor's as compared with the manufacturer's boy. In some cases it would be impossible to fulfil the conditions. In most, it would be difficult. And quite evidently the contractor, in the mass, would sacrifice many more hours annually of productive work than the manufacturers would. Again, as a class, he is probably less able to bear such loss.

It seems therefore that only in an exceptional case can an apprenticeship with an electrical contractor be commenced unless the boy is 16 and has attended the approved day courses till that age.

I do not wish to suggest that the peculiar conditions under which the contractor's apprentice serves should act as a pretext for his employer to evade the granting of facilities for continued mental training. Contractors could do far more than they have done by way of bringing out the abilities and improving the efficiency of their apprentices. The boys have been hitherto left too much to their own devices. The masters have not troubled to guide or keep in touch with their class work. Haphazard and false notions of electrical theory have been easily acquired, and bad theory has resulted in defective practice.

Employer, workman, and apprentice have all, probably, been too intent on the pay sheet, and have lost sight of the good of the craft, which should be the grand binding link between them.

A boy may owe much to the friendly skilled tradesman or foreman who has helped him tactfully. On the other hand, in some shops, apprentices have suffered by being in the company of that kind of man who objects to having what he calls his brains "picked." The man who is reluctant to impart his knowledge generally has a good reason for his reticence. In most instances, however, it is simply indifference that has put the drags on knowledge.

What we want to do now is to make every apprentice realise that his chance has come and is passing, and that with a slight but continued effort, he can conquer the giants on the path and find the electrical field opening out before him with mental delights beyond Elysia.

I do not think that the employers should attempt to interfere with the methods and work of the professional teachers. Anything they do should be superadded to the curriculum of the trained technical theorist, but there are ways in which they might peculiarly help the aspirant for electrical knowledge. These might be extended or modified later.

My first proposal would be that in each town the contractors would arrange a series of informal

lectures on an approved set of electrical subjects. These would be held in a building which also contained an electrical library. The lectures would be, say, of one hour's duration, and, where possible, would be illustrated in a practical fashion. Every available apprentice would be required to put in attendance at two of these per week for six months in the year. There would be no examination, but questions would be encouraged. Each youth would have to keep a notebook, and every week would show what new set of facts he had added to his knowledge. To engrain the habit of systematic note-taking would in itself greatly add to efficiency.

Probably there would not be much difficulty in most towns in finding volunteers from among the more capable employers and their foremen, who would prepare and give each a short set of lectures on some approved subject in which they were more or less expert. Those who undertook the work would find the rubbing-up of great benefit to themselves.

There might be a set of two or three lectures on such subjects to begin with as "primary batteries," "bells," "switches," "motor connections," "heaters," &c., &c. Such a scheme would be quite popular if enthusiastically fulfilled, and the boys might earn tools, or badges—as the Scouts do—for proficiency in particular subjects. Holding such practical bi-weekly meetings under the charge of practical men does not get over the difficulty of dealing with the youths who are on a country job or cannot otherwise conveniently attend. The difficulty would be partly met if it were the rule not to keep the same boy away for a period of more than three months in the year.

My second proposal would be that in addition to the lectures, a card system of teaching elementary theory be applied to all apprentices. The subject of elementary electricity and engineering could be treated in a set of expressive paragraphs. These with illustrations and simple exercises should be attractively printed on cards. There would be a card for every week of a boy's apprenticeship, and it would be handed to him each week-end. No matter where he was employed the apprentice would have the opportunity of learning each week a progressive series of facts which would be useful to him. This "constant drip" plan of teaching has, of course, been applied with great success to the teaching of languages. It has even, to a limited extent, been applied to electricity. Glover's Almanac gave us some intermittent flashes of this mode of instruction.

I feel sure the method would well repay the small outlay. The instruction on the cards would require to be carefully considered by a good teacher, who also knows the practical work. It will not do simply to chop up some existing text book.

The purpose of this short article is to inform those contractors who do not already know it—that their apprentices will be affected by the impending English and Scottish Education Acts.

It also suggests that the interests of the craft as a whole would be well served if: First, apprenticeship starts at 16 at earliest after a year of special day-class preparation. Second, if employers encourage and help to provide facilities for lecture, library, and notebook-keeping on the part of their apprentices. Third, if a course of card training in electrical engineering lasting 250 weeks be given to each.

In many districts now the apprentices are registered by the local trade association, and the final certificate of apprenticeship is valued both by masters and men. Such certificate, if endorsed with marks which showed that suggested courses had been taken full advantage of, would indicate that the apprentice was progressing into the state of real electrical craftsmanship.

CHARGING ELECTRIC TRUCK BATTERIES.

By G. J. DUCKETT.

About four years ago I had to make provision to charge one of these vehicles; as they are of very low voltage (usually 24 volts), it is customary to install a motor-generator, the motor taking current at the district supply voltage—very often 200 or 400 volts—and the generator giving a supply at a pressure up to 50 volts.

The proprietors of the truck did not wish to go to the expense of installing a rather costly charging set, as the truck was purely experimental; and, therefore, it was charged off the supply company's mains, the voltage of which was 250, the current being reduced to a suitable amount by the use of cast-iron resistances.

The average capacity of the batteries of these trucks is approximately 240 ampere-hours, and the normal charging rate is 45-60 amperes. The cost of charging one of the trucks would therefore be:—

$$250 \text{ volts} \times 60 \text{ amperes}/1{,}000 = 15 \text{ units},$$

and, at 2d. per unit, would be $15 \times 2 = 2$s. 6d. per hour, or, for a full charge, it would work out at exactly 10s.

Now if the supply pressure was at the normal truck battery voltage, the cost would work out as follows (a 24-volt acid battery of 240 ampere-hour capacity would require between 30 and 32 volts to charge it at a 60-ampere rate, therefore we will assume that the average voltage required is 32):—

$$32 \text{ volts} \times 60/1{,}000 \text{ at 2d.} = 3{\cdot}8\text{d. per hour},$$

or, for a full charge, the cost would be 1s. 3½d. approximately, thus showing a saving of 8s. 8½d. when compared with the 250-volt method, and, at the same time, obtaining exactly the same results.

Eventually the truck so proved its worth that it was decided to install a motor-generator, but, owing to war measures, we now found that we were unable to obtain one;

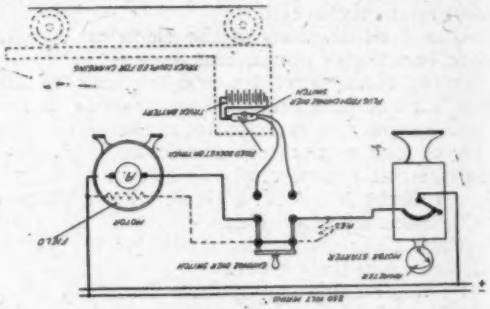

Fig 1.—Connections for Charging Battery through Change-over Switch.

also, the question of reducing the consumption of electricity cropped up, and it looked at first as though the truck would have to be put out of commission until such time as we were permitted to obtain a motor-generator.

Various methods of charging, however, were considered, and we eventually solved the problem by using the negative return circuit of a motor taking a fairly steady current of 40 amperes at 250 volts.

At first an ordinary change-over switch was used, as shown in fig. 1, but we found that this method was rather dangerous, and caused somewhat erratic running of the motor; so an automatic contactor switch was devised, as shown on the diagram, fig. 2. The arrangement operates in the following manner:—

When the motor M is running directly across the 250-volt supply, the contactor contacts F C, M C, and C_1, C_2 and C_4 are closed, but when the battery B of the truck is ready for charging, the plug P is pushed into the socket S, after which the push P_1 is pressed, and the contactor coil C C energises the contactor magnet C M with current from the battery B. On releasing the push P_1 a resistance R_1 is inserted in the contactor coil C C, but the pull of the coil core C M is sufficient to retain the armature A.

The contactor contacts F C and M C, which are mechanically fixed to the armature A, are now pulled off their respective contacts F_1 and C_3, resulting in an additional

resistance F R being inserted in the field circuit and M C making contact with C_2.

The current which is being taken by the motor M now flows to the battery B, thus charging it. Under normal conditions, the speed of the motor M would be somewhat reduced owing to the loss of voltage due to the opposing voltage of the battery; but this reduction in speed is compensated by the resistance F R which is now inserted in the motor field, which, of course, speeds up the armature, and by adjustment it is possible to obtain exactly the same speed as was originally obtained.

Owing to the increase of field resistance the armature of the motor takes approximately 25 per cent. more current to drive it; therefore, the current passing through the battery during charging will be 50 amperes. Although the

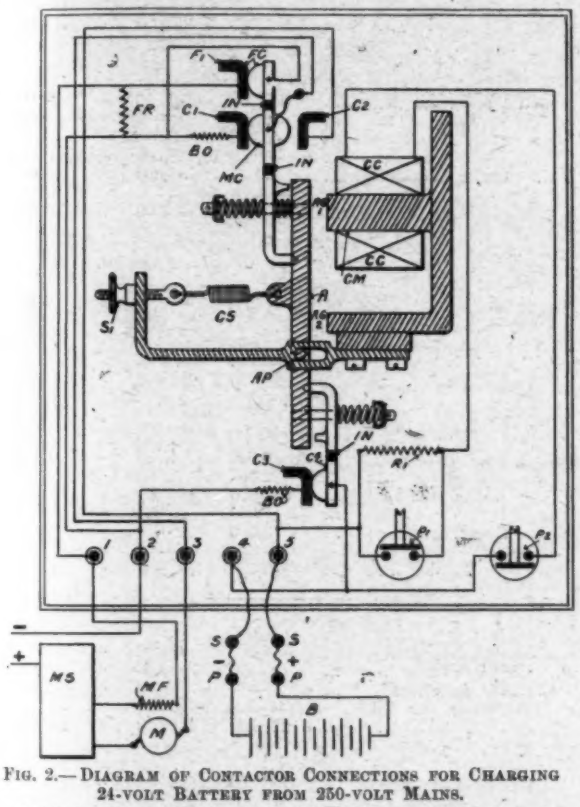

Fig. 2.—Diagram of Contactor Connections for Charging 24-volt Battery from 250-volt Mains.

M S, Motor starter; M, Motor; M F, Motor field; C M, Contactor magnet; C C, Contactor coil; B O, Blow-out coil; A, Contactor armature; F C, Field contacts; C_1, C_2, Fixed contacts; M C, Movable contact; C S, Contact adjusting spring; S_1, Adjusting nut; P_1, "On" Push; P_2, "Off" push; F R, Aux field resistance; C_3, Fixed contact; C, C, C, Movable contact; B, Truck battery; 1, 2, 3, 4, 5, Terminals; R_1, Contactor coil resistance; I N, Insulation; A P, Armature pivot; A G_1, Air gap; A G_2, Air gap.

battery is receiving a charge of 50 amperes, the actual increase in current used is 10 amperes, and the cost of charging is as follows:—

10 amperes × 250 volts/1,000 at 2d. = 5d.

per hour, or 1s. 8d. per complete charge—a saving of 8s. 4d. per charge when compared with the resistance method.

If the battery is fully charged, or the truck is required, the push P_2 is pressed, the contactor coil C M is de-energised and the armature A dropped off, allowing the contacts F C and M C to bridge their respective contacts F_1 and C_1.

If by accident or otherwise the plug P is withdrawn from its socket S before the push P_2 has been pressed, the contactor coil C M is energised from the 250-volt motor supply, and the tension spring S is overcome, and the contacts C_3 and C_4 are open-circuited, thus cutting off the main supply to the motor, and at the same time preventing serious arcing at the plug and socket contacts.

The charging arrangement I have described is situated near one of the loading stations, and we find it is not necessary to take the truck out of traffic for the purpose of charging, as the driver of the vehicle plugs in the battery of the truck every time he has a few minutes' stop during loading, &c.

WALSALL ELECTRICITY SUPPLY.

The following is an abstract of the report of a Committee which considered certain remarks made by Coun. Talbot at the Council meeting on November 13th with regard to interruptions to supply and coal consumption at the Birchills power station. Coun. Talbot at a later date disclaimed the broad statements which he had made. The report, which was adopted by the Council, stated that whilst the statements in question appeared to cast a reflection on the borough electrical engineer and his staff, Councillor Talbot, on this aspect of the matter being brought to his attention, disclaimed any intention to cast such a reflection; and the Committee placed on record its entire confidence in Mr. H. A. Howie and his staff. The report continued:—

Interruptions to Supply.—In connection with new plant of any kind difficulties must inevitably arise during the first months of working which might reasonably be expected to diminish or disappear in course of time, and the new station at Birchills had not been free from such difficulties. The stoppages which had occurred were not wholly or even mainly due to the station plant. Several tramway stoppages, for instance, occurred owing to the breaking of tramway wires and consequent short-circuiting.

During the past three months there had been altogether two general stoppages and five partial stoppages. Of those seven stoppages the most serious was that on Saturday, September 21st, when the tramway service was interrupted for a period of nearly four hours; all the other services, however, were maintained. This stoppage was due to an insufficient supply of town's water, caused by the breaking that day of one of the South Staffordshire Water Co.'s mains. That, however, would not have caused an interruption had it not happened to coincide with a date when one of the turbo sets was being overhauled. Arrangements had since been made whereby the supply would be maintained even in the extremely unlikely event of such a coincidence again happening.

Of the other six stoppages, one was due to the 250-kw. tramway rotary converter at Darwall Street sub-station being too small to deal with the Saturday evening load, and the Council had since approved the purchase of a new 500-kw. rotary converter to cope with that load. Two of the stoppages were due to the burning of low-grade fuel (anthracite slack and coke breeze dust) at the express desire of the Coal Supplies Committee of the Board of Trade. One stoppage was primarily due to an error of judgment on the part of the charge engineer. Of the two remaining stoppages, one was due to the safety overspeed device being set at too near the normal running speed. Owing to an external fluctuation on the load the safety device came into operation and shut off the steam, causing a stoppage of 15 minutes. The remaining stoppage was due to a hot bearing on the auxiliary plant.

In no case could the stoppages be attributed to any defect in the design or construction of the plant or station. There had been no stoppage whatever since October 24th last, though during that period there had been the maximum load and the largest output in the history of the undertaking.

Until a third generating set was installed at Birchills in accordance with the original design there would always be the risk of a short interruption of supply should the running set fail in any way.

Coal Consumption.—Since the question was considered and reported on by the Committee in detail 12 months ago, the Committee had had before it reports which showed that the results obtained were in accordance with expectations, and that the general efficiency of the Birchills power station compared very favourably with larger power stations operating under far better load conditions. The records also showed that the results were steadily improving with the growth of the load. In the four weeks ended November 17th, with poor quality coal containing 22 per cent. ash and with 10 per cent. of coke dust, the average fuel consumption per unit sent out was 4.97 lb. and per unit generated 4.19 lb.

After making proper allowance for the low value fuel and the fact that the turbine was only about half loaded, the figures obtained showed that the plant was being worked economically and was capable of 3 lb. per unit sent out when working under favourable conditions.

The committee had received from an independent and impartial source, viz., the technical adviser to the Coal Controller, London, who recently inspected the station and records, information which conclusively showed that the coal consumption at Birchills was lower and the overall thermal efficiency higher than at any of the other stations of comparable output in No. 10 (West Midlands) District. If the absolute figures were taken, without any reference to output or load factor, Walsall stood seventh among the 17 stations in No. 10 District (which included Birmingham, Coventry, Wolverhampton, West Bromwich, and the Shropshire, Worcestershire, and Staffordshire Power Co.'s and

Midland Electric Power Corporation's Undertakings). The latest returns of coal consumption at the 17 stations in No. 10 District were given by the Coal Controller as follows:—

	Lb.
Highest consumption of coal per unit generated ...	9.0
Lowest consumption of coal per unit generated ...	3.19
Average consumption of coal per unit generated ...	3.77
Walsall consumption of coal per unit generated ...	4.19

These figures took no account of load factor; Walsall's load factor was low, and there was a much larger margin of spare plant at Walsall than at most other stations. Whilst that put Walsall in a peculiarly favourable position for development immediately war restrictions were removed, in the meantime the coal consumption figures could not be expected to be so good as they might be.

In view of the comparatively heavy coal consumption during periods of light loads, the suggestion that it might be advisable to install at Birchills a small turbo-alternator to take up the light loads had a certain amount of attractiveness on a superficial view, but the proposal was financially and economically unsound. The Council and the Committee were perfectly satisfied on the point.

In spite of all handicaps the progress of the undertaking, since the installation of the two sets was completed, had been eminently satisfactory. The Committee was confident that the most difficult period was now past, and that there was an excellent future before the undertaking if it was allowed to continue and develop the policy laid down five years ago.

TRADE STATISTICS OF CANADA.

The following figures, showing the imports into and exports from Canada of electrical and similar materials during the year ended March 31st, 1917, are taken from the recently-issued trade statistics. Figures for the year 1915-16 are given for purposes of comparison, and notes of any increases or decreases have been added:—

IMPORTS.

	1915-16. Dols.	1916-17. Dols.	Inc. or dec. Dols.
Copper wire, plain, tinned, or plated.—			
From United States ...	18,000	35,000	+ 17,000
Electric light carbons and carbon points.—			
From United States ...	50,000	66,000	+ 16,000
,, Other countries ...	2,000*	—	– 2,000
Total	52,000	66,000	+ 14,000
* Switzerland $2,000.			
Incandescent lamp bulbs, &c.—			
From France	1,000	1,000	—
,, United States ...	62,000	115,000	+ 53,000
,, Other countries ...	—	1,000	+ 1,000
Total	63,000	117,000	+ 54,000
Electric apparatus not mentioned (insulators, batteries, telegraph and telephone instruments).—			
From United Kingdom ...	207,000	109,000	– 98,000
,, France	2,000	2,000	—
,, Japan	—	1,000	+ 1,000
,, Sweden	3,000	3,000	—
,, Switzerland ...	—	5,000	+ 5,000
,, Italy	3,000	—	– 3,000
,, United States ...	3,367,000	4,174,000	+ 807,000
,, Other countries ...	—	1,000	+ 1,000
Total	3,582,000	4,295,000	+ 713,000
Manufactures of india-rubber and gutta-percha (except tires, clothing, and similar goods).—			
From United Kingdom ...	193,000	213,000	+ 20,000
,, France	2,000	3,000	+ 1,000
,, Japan	—	23,000	+ 23,000
,, United States ...	625,000	773,000	+ 148,000
,, Other countries ...	2,000	—	– 2,000
Total	822,000	1,012,000	+ 190,000
Gasoline engines.—			
From United Kingdom ...	32,000	26,000	– 6,000
,, United States ...	3,376,000	4,789,000	+ 1,413,000
,, Other countries ...	1,000	—	– 1,000
Total	3,409,000	4,815,000	+ 1,406,000
Steam engines.—			
From United Kingdom ...	12,000	1,000	– 11,000
,, United States ...	95,000	275,000	+ 180,000
Total	107,000	276,000	+ 169,000
Steam boilers.—			
From United Kingdom ...	33,000	55,000	+ 22,000
,, United States ...	81,000	155,000	+ 74,000
Total	114,000	210,000	+ 96,000
Concrete mixing, cement-making, and coal-handling machines.—			
From United Kingdom ...	1,000	—	– 1,000
,, United States ...	91,000	185,000	+ 94,000
Total	92,000	185,000	+ 93,000
Electric motors, generators, and dynamos.—			
From United Kingdom ...	35,000	66,000	+ 31,000
,, Sweden	2,000	3,000	+ 1,000
,, United States ...	863,000	1,397,000	+ 534,000
,, Other countries ...	1,000	—	– 1,000
Total	901,000	1,466,000	+ 565,000
Machinery not mentioned, except sewing machines, textile machinery, printing machinery, &c.—			
From United Kingdom ...	302,000	312,000	+ 10,000
,, France	2,000	—	– 2,000
,, Switzerland ...	46,000	8,000	– 38,000
,, United States ...	12,140,000	18,538,000	+ 6,398,000
,, Other countries ...	7,000	38,000	+ 31,000
Total	12,497,000	18,896,000	+ 6,399,000
Iron and steel wire, single or several, covered with cotton, linen, silk, rubber, or other material, including cables so covered.—			
From United Kingdom ...	5,000	25,000	+ 20,000
,, United States ...	160,000	188,000	+ 28,000
,, Other countries ...	1,000*	—	– 1,000
Total	166,000	213,000	+ 47,000
* France.			
Lighting fixtures of metal (including electric).—			
From United Kingdom ...	10,000	4,000	– 6,000
,, France	2,000	3,000	+ 1,000
,, United States ...	310,000	448,000	+ 138,000
,, Japan	5,000	15,000	+ 10,000
,, Other countries ...	3,000	—	– 3,000
Total	330,000	470,000	+ 140,000

EXPORTS.

Mica.—			
To United Kingdom ...	34,000	48,000	+ 14,000
,, United States	195,000	382,000	+ 187,000
,, Other countries ...	—	1,000	+ 1,000
Total	229,000	431,000	+ 202,000
Electrical apparatus.—			
To United Kingdom ...	142,000	295,000	+ 153,000
,, Newfoundland ...	17,000	36,000	+ 19,000
,, United States	52,000	179,000	+ 127,000
,, France	17,000	636,000	+ 619,000
,, Spain	340,000	193,000	– 147,000
,, Other countries ...	5,000	19,000	+ 14,000
Total	573,000	1,358,000	+ 785,000
Machinery (other than threshing, linotype, washing, and sewing machines).—			
To United Kingdom ...	252,000	521,000	+ 269,000
,, Newfoundland ...	23,000	38,000	+ 15,000
,, New Zealand	2,000	4,000	+ 2,000
,, Argentina	2,000	—	– 2,000
,, France	12,000	55,000	+ 43,000
,, United States	371,000	679,000	+ 308,000
,, Russia	34,000	55,000	+ 21,000
,, Australia	7,000	15,000	+ 8,000
,, Spain	2,000	23,000	+ 21,000
,, Other countries ...	35,000	55,000	+ 20,000
Total	740,000	1,445,000	+ 705,000
Gasoline engines.—			
To United Kingdom ...	10,000	—	– 10,000
,, Newfoundland ...	63,000	118,000	+ 55,000
,, United States	11,000	12,000	+ 1,000
,, Oher countries ...	2,000	4,000	+ 2,000
Total	86,000	134,000	+ 48,000

Relaxation of Export Restrictions.—Further changes in Export Prohibition Orders appear in the *London Gazette* for December 13th.

ELECTRICITY IN STONE HANDLING.

By G. BASIL BARHAM.

Every engineer is aware of the many uses to which electricity can be applied in stone handling and stone working generally, but so far few British firms have specialised in the manufacture of electrically-operated appliances designed for dealing with sand, gravel, ballast, and crushed stone. It may be that an opinion exists that there is an insufficient demand to justify the expenditure on designs and patterns, or it may be that due attention has not yet been directed to the subject. There is a lamentable lack of co-ordination between electrical manufacturers as a whole, and those responsible for the conducting of industrial undertakings. The former seem perfectly contented, as a general thing, to fill a demand if it is thrust upon them, and seldom seem to go out of their way to see what aditional demands can be created.

One of the most recent developments in connection with stone-handling machinery has been the production of an electric gravel shovel which travels on skids, digging a channel, and providing material at the same time. One of these is now at work in the construction of two retaining walls at Los Angeles. The river is being dredged out and confined to a narrower channel by means of two immense walls, one of which is 1,000 and the other 4,300 feet in length.

The electric shovel is mounted on skids, and is operated by means of a continuous-current motor which drives the excavator jaws, controls their movement so as to empty their contents into dump cars, and at the same time operates a slow-speed winch which winds a steel rope anchored some distance in advance of the machine, the whole of the operations being perfectly synchronised. In the ordinary type of excavator it is necessary to move the machine along on rollers, but the skids render these unnecessary.

The shovel, starting at a point near the concrete mixer, works its way along, digging out the bed to a depth of 20 ft., and filling dump cars which run alongside on a narrow-gauge track carrying the material to the mixer. At present these cars are hauled by a small engine, but ultimately they will be hauled by electric power, thus reducing working costs. The cars are drawn one at a time up an incline and dumped automatically into the concrete mixer in the following ingenious manner.

Two small supplementary wheels are mounted on the extended ends of the rear axle of each car. On reaching the top of the incline these wheels start to travel along beams, which are placed at a fairly sharp angle, so that the load is gradually tilted forward until past the centre of gravity. A tripping device fixed by the side of the road track then engages a catch holding the front of the car in place so that it is allowed to drop, and the stone or gravel falls forward into the mixer. For the purpose of providing conveyors whose range can be extended as the work progresses, sets of cables have been stretched from the stone-crushing plant and the mixers to points where the concrete is to be used. Frame sections are laid on these wires to form suspended supports, to the end of which the sand, stone, or concrete can be carried and dumped. As the work proceeds fresh sections are laid, these being removed from that part of the wall which has been completed. It is interesting to note that in order that the sorted material which is in excess of the requirements of the work can be easily loaded for delivery to purchasers, a reinforced concrete tunnel has been built along the length of the work. Into this passageway the delivery trucks are driven, and any superfluous material can be loaded into them by the simple expedient of removing one or more of the frame sections mentioned and dumping down the desired amount of sand or gravel.

An electric hoist has recently been designed by a leading firm of trans-Atlantic engineers especially for use in connection with slack-line, cableway excavators of the drag bucket type. This hoist is built for all sizes of buckets up to 2½ cubic yards capacity. The rear drum is worked on a single speed, but the front drum is provided with two speeds, because it is used for the dual work of loading the bucket at a reasonably slow speed suited to excavating, and for hauling on the track cable to the dumping point as quickly as possible. Naturally, to obtain maximum capacity with this type of excavator, the bucket must be conveyed from the digging point to the dumping ground at the speediest possible rate.

In order to obtain two speeds on the front drum, two gear reductions are provided, one at either end, the drum being fitted with two specially designed, high-speed friction clutches. By means of engaging one friction clutch with the slow-speed reduction it is possible to obtain sufficient power to load the bucket at a speed of 200 ft. per minute. After the bucket is filled this slow-speed clutch is thrown off, and the friction clutch at the opposite end is engaged with the high-speed gear ratio. The duty of the drum is then sufficient to haul in the loaded bucket at a speed of 600 ft. per minute. After the load has been discharged, the front drum is thrown into the neutral position, at which point neither of the frictions are engaged, and the drum runs free on its shaft. The bucket is thus returned to the excavation by gravity at a high rate of speed. The rear drum of the hoist is used for tensioning the track cable, and delivers a duty sufficient for this purpose at a speed of 200 ft. per minute.

Another newly-designed form of electrically-operated stone-handling plant is a skip hoist, which consists of a bucket running on inclined or vertical tracks, and hoisted by means of a steel cable attached to an electrically-driven drum. The bucket consists merely of a rectangular steel box open at the top, and fitted with guide rollers and hoist bale.

The bucket is started by a rope attached to the motor controller, or, if preferred, a push button control, such as is used for "inching" with electrically-driven printing machinery can be installed. Automatic control is fitted to the bucket so that it discharges on reaching a given position and returns to the pit. It is possible also to synchronise the movements of the bucket with a filling device so that as soon as a desired amount of material is loaded the bucket automatically starts. This hoist can be used with a small electric car to move the material a short distance to the loading hopper, or it can be used with a drag-line bucket.

It is claimed that a 35 cubic ft. trolley hopper car on a 130-ft. haul, travelling at a speed of 400 ft. per minute, can make a round trip in two minutes, including filling and dumping, assuming that the material will flow by gravity into the car. This equals 40 tons per hour for the extreme, or 20 tons per hour for the average haul. A skip, consisting of two buckets, one going up whilst the other is coming down, can make a trip in 90 seconds, including filling and dumping. If the buckets are 35 cubic ft. capacity each, it would give 28 tons per hour at 50 cubic ft. per ton and a 50-ft. lift. The 20 cubic ft. single-bucket skips, on a 50-ft. lift at 40 ft. per minute, can handle 8 tons per hour, and this size of hoist only requires a 6-h.p. motor. Only one attendant is required to fill the hopper and start the hoist, and where a continuously operating excavator is used, and automatic filling adopted, one man is sufficient to handle even the largest plant.

CORRESPONDENCE.

Letters received by us after 5 p.m. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Super-Stations and Aircraft.

I regret that in my letter of the 4th instant a typographical error was made. The waterways—Clyde, Solway Firth, and Ribble—were omitted between the words Caledonian Canal and Mersey.

C. T. Allan,
Assistant Manager, South Wales E.P.D. Co.
Cardiff, *December 16th*, 1918.

A Six-Hour Day?

I notice that for a long time past Lord Leverhulme has been delivering speeches advocating a six-hour day. Many extracts to this effect have come before me, but I have not notice that other manufacturers are replying to, or approving of, his proposals. Does this mean that there is general agreement in industry that the two-shift, six-hour day giving employment to double the number of workers is the right thing? If such is not the case it is a little dangerous to allow the idea to spread. Are the conditions everywhere the same as prevail in a soap works? In one of his latest speeches, Lord Leverhulme gives as one reason for his proposal the fact that new factories to give employment for demobilised workers will cost 75 per cent. more than the old, and that the cost of machinery is doubled. What are the industries that he has in mind when he talks of the need of new factories for the employment of millions of workers? It might be helpful if he would particularise a bit. Does he overlook all the new works that have been erected by private concerns and by the Government itself?—works that will be free for ordinary industry, and presumably in the disposal of "war stores, &c.," will be offered at something less than the present-day high cost of factory erection? Shorter hours as a means of giving employment to larger numbers of workers—let us have these wherever we can give a living wage; but an indiscriminate and general cry for six hours seems more likely to hinder than to help us in discovering a solution to the difficulties of demobilisation. Surely when the engineering employers—who know their own industries better than they know the soap business—arrive at an agreement with the men for 47 hours a week, and only the very advanced section of the men clamour for 44, it is confusing when a leader of industry encourages the idea that 36 hours is all that any man ought to be required to work. Railway workers are to have the eight-hour day early in the year, and even the transport workers are only *asking* for a 44-hour week. It is true that there is a 36-hour demand among some of the trades on Tyneside, the Clyde, and at Belfast, perhaps fed by Lord Leverhulme's speeches, and it will be interesting to hear what the employers have to say. It may be easy to make a demand without allowing properly for the technical difficulties which may stand in the way of its realisation. I do not desire to be too critical

of the efforts of those who are trying to secure the introduction of improved conditions and hours of labour, but I should very much like to see the views of some industrial leaders, who must be thinking a great deal, though saying little, on this important subject.

A. H. B.

London, *December 16th*, 1918.

Smooth versus Undercut Commutators.

I have been very interested in the correspondence on the above subject in your columns, and I note that practically all your correspondents have had the same experience as I have, namely, that, provided the undercutting is properly done, and care is taken that the conditions are suitable, it has very great advantages. I have always found trouble resulting from it when care is not taken to do the work properly.

In the case of an electric railway company in Mexico, with which I was connected, they were operating motor-cars and locomotives at 1,100 volts D.C., under very severe conditions of grades and loads. They had no sparking trouble with the motor cars which had 1,100-volt motors and undercut commutators, but with the locomotives which had 550-volt motors permanently connected in series, and a much lower rate of commutation and lower voltage between segments, they had a great deal of sparking trouble, until the mica was undercut about 1½ mm., when it practically all ceased. They also had considerable trouble on the 50-cycle rotary converters with sparking and flashing, on those without undercut commutators, but on two 550-volt rotaries which were built with the mica about 8 mm. below the copper, no trouble was ever experienced. Neither did any trouble due to dirt between the segments occur in these, in spite of the very deep undercutting and the use of soft graphite brushes; this I attribute to centrifugal force throwing the dirt out, as the commutators were about 800 mm. diameter, and ran at 1,500 R.P.M.

G. H. E. Vivian, A.M.I.E.E.

Newark-on-Trent, *December 14th*, 1918.

May I add my experiences to those of your correspondents who are in favour of undercutting the mica insulation of commutators?

I am in charge of a number of rotary converters, some of which are of an old type. Two of them gave more trouble than the rest, sparking badly at the D.C. brushes.

I had the mica undercut, with the result that they gave much improved service, the sparking in the case of one being almost entirely eliminated, even on overloads.

Hard carbon brushes work well, but, as it is advisable not to lubricate the commutators much, they are rather noisy. A little paraffin wax lightly applied is a good lubricant. Morganite brushes are very successful, as they do not require any lubrication.

My experience is that the brushes last longer and do not get so hot as they did before the slotting was done.

The mica should be cut down occasionally, a hacksaw blade passed along the slots will clear them of any accumulation of grease or carbon dust.

J. Hunt.

Ramsgate, *December 14th*, 1918.

I had thought quite enough had been said in favour of undercut commutators.

Since reading a letter in your issue of the 13th on the above subject, I feel I ought to write fully endorsing the views of Mr. W. Parker.

I have had over 17 years' experience in gas engine stations where machines all run under the worst possible conditions, all brass and copper work soon loses its brilliancy, and polishing is only a waste of time and material, the commutators on my machines from ¼ to 300 H.P. are almost as black as ink, having become oxidised by the gas, but commutation is perfect and the commutator cool. Whatever theory may have to say on the matter, the proof of the pudding is in the eating. I have the mica filed down, for which purpose I use "v" files, and once done it is an easy matter to run them through about once a month, but the surface of the commutator is untouched with either emery or carborundum cloth.

The greatest difficulty to overcome in a gas-driven station working on producer gas is the oil vapour drawn in by the machines, which adheres to the windings and the back of the commutator, on which dust readily collects. The exterior parts are easily cleaned, but what about the interior? I ought to say even with "totally enclosed" machines the same trouble arises unless they are pipe-ventilated.

Now here I must say a few words which I hope my manufacturing friends will treat kindly—approaching them on the subject, their only cure so far is an extra coat of varnish, which is by no means sufficient; ventilation, as we know, is an important factor, so also is high efficiency and cheap production, but surely a little ingenuity on their part would not impair the above factors, but obviate this oily vapour nuisance. May I make a suggestion? which I am almost afraid to do, namely, a belt of fine gauze or oil filter pad strapped round the protruding end of the armature, which could be taken off and cleaned occasionally.

I have tried to be as brief as possible, but shall be pleased to give any information to either users or makers of machines of my experiences on the above subjects.

A. Preston.

Ammanford, *December 16th*, 1918.

Gas versus Electricity.

I have pleasure in enclosing copy of my letter of December 5th, addressed to the Director of Electric Power Supply, and copy of Mr. Gridley's reply on December 6th, for publication in your Journal.

The matter will, I feel sure, be of general interest to your readers.

H. Faraday Proctor,
Hon. Sec., I.M.E.A.

Bristol, *December 13th*, 1918.

[COPY.]

December 5th, 1918.

Arnold B. Gridley, Esq.,
Director of Electric Power Supply,
Room No. 401,
Ministry of Munitions of War,
8, Northumberland Avenue,
London, W.C. 2.

DEAR MR. GRIDLEY,—At the last meeting of the Council of the I.M.E.A. the letter of Mr. Rogerson, borough electrical engineer of Halifax, dated November 14th, and addressed to yourself, was considered. The letter contains the following paragraph:—

"It is presumed the chief reason for encouraging the use of gas, namely, the one referred to in your circular of September 17th last (the importance for war purposes of the residuals from the gasification of coal) has now lost its force with the reduction or cessation of the demand for explosives."

The Council requested me to write to you asking whether you would secure freedom of choice in the use of gas or electricity to consumers or prospective consumers in preference to the existing arrangement, which favours the utilisation of gas due to war requirements.

Yours very faithfully,
(Signed) H. FARADAY PROCTOR,
Hon. Sec.

[COPY.]

Ministry of Munitions of War,
8, Northumberland Avenue,
London, W.C. 2.

H. Faraday Proctor, Esq., *December 6th*, 1918.
Hon. Secretary,
Incorporated Municipal Electrical Association,
The Exchange,
Bristol.

DEAR SIR,—I am directed to refer to your letter of the 5th inst., and to say that the fact that a gas supply may be available on the premises need now no longer be a reason for declining to entertain applications for supplies of current for domestic purposes.

In modifying to this extent the restrictions which have hitherto held, I would remind you that until the coal situation has materially improved, the Electricity (Restriction of New Supply) Order, 1918, must unfortunately remain in operation.

I am, Sir,
Your obedient servant,
(Signed) A. B. GRIDLEY,
Director of Electric Power Supply.

LEGAL.

THE FLEMING VALVE.—PETITION FOR PROLONGATION OF PATENT.

(*Concluded from page 570.*)

Cross-examined by Mr. COLEFAX, K.C. (for the British Thomson-Houston Co., Ltd., and others, opponents of the petition), in connection with the patents of Dr. de Forest and his grid patent of 1908, Mr. PLETTS said it was the contention of the Marconi Co. that all grid valves that rectified infringed Fleming's 1904 patent.

There has been nothing during the life of this patent to interfere with the free use by the Marconi Co. and all their customers or associated companies making use of the Fleming valve?—No.

Cross-examined by Mr. T. TERRELL, K.C., for the Crown, witness said he was aware that the Marconi Co. had been in litigation with the Post Office for breach of contract, and that they were claiming damages for loss of royalties which they would have earned under the contract if it had not been broken, for the use of their patents.

And this patent forms the most important factor in that claim for damages?—It forms, I should say, the most important patent from this year onwards.

And for past years?—The Lodge patent expired in 1917.

Re-examined by Mr. J. H. Gray, K.C.: It is quite wrong to say royalties are being claimed. The fact is, it is a percentage of the cost of the messages which would have been sent during the year in any particular year.

Witness further said that licences had been granted for the English or foreign patents to other companies. The Marconi Co. had shares in those other companies.

By Mr. Justice Sargant: Did you push the sale of this apparatus commercially in the market just as if you had been only non-users, so as to sell to all your rivals and everybody in the market?—There were customers; we sold to people who had our apparatus.

Mr. Pletts added that, so far as he knew, they sold them to any person who wanted them.

Mr. William Walter Bradfield, manager of the Marconi Co., produced a document showing in the case of each of the subsidiary companies of the Marconi Co. the number of shares held by the Marconi Co. in those companies, and the total dividends which had been received in each year from them. Generally speaking, in the case of each of the subsidiary companies, as part of the consideration from the Marconi Co. to them, there was either an assignment in general of all patents of licences for all patents present and future made by the Marconi Co. in the particular country. The first was the Marconi International Marine, which showed by far the largest total dividends received—£84,500. The number of patents involved in the various transfers amounted to 160. The Marconi Wireless Co. of America paid a dividend of £4,082 in 1912. In 1917 the American Marconi Co. paid the Marconi Wireless Telegraph Co. £10,000 in dividends. That was chiefly attributable to the fact that the American Co. was doing a tremendous amount of work. It was selling all sorts of military apparatus, both to the Army and Navy authorities. The French Marconi Co. had paid the English Co. £1,446, rising gradually to £7,760 in 1917. The Belgian Co. had paid no dividend since 1911. The Russian Co. paid up to the time of the trouble in Russia in 1916 a dividend of £2,971. The Australian Co. paid dividends from 1913 up to date amounting in the last year to £1,800. He believed the Australian Co. had something like half a dozen ships that had been fitted with valves during this last year. Witness was of opinion that the other companies had not used valves, at any rate commercially, but might have done so experimentally.

Prof. E. W. Marchant and Sir Dugald Clark said they regarded Prof. Fleming's invention as of very great importance.

The petitioners' case was closed, and

Mr. Moritz, addressing the Court on the evidence, said the two main features in the case were outstanding merit and insufficient remuneration.

On Wednesday, December 11th, Mr. Colefax, opening the case for the opponents (six), said it was not that they feared an issue of infringement or an issue of validity with regard to the patent, but they had been made aware of the extraordinary claims which the Marconi Co. had been making in respect of the patent, and accordingly they thought it right to enter opposition to the petition for prolongation. One matter that had not escaped the notice of those interested in such matters was the subtle transition that appeared in the Marconi patents when referring to the three-electrode valve. Up to a certain time it was recognised by that name, by which it was known in the electrical world, and then it came to be called the Fleming valve. The case was unique almost in this respect, that there never had been any difficulty whatever or any disinclination on the part of the public to use the invention, or any difficulty on the part of the company in putting the invention into operation. During the whole of the life of the patent, subject only to the growth of the use of wireless, it had been of equal value. His contention was that there was no invention at all. There was no conflict that the instrument was old; its use for rectifying alternating currents was also old. Whatever use, if any, there had been of the invention Dr. Fleming made in 1904, it was absolutely negligible. The kind of case that was suggested for the petitioners was that long-distance wireless was rendered possible by it, or rendered more efficient by it. They said that, in substance, long-distance wireless dated from 1908. But in a wireless book it was stated that in 1902 long-distance signalling was done at 1,550 miles. There was plenty of evidence that what they did was to use the Fleming valve (as a matter of fact, it was not the Fleming valve, but the de Forest valve) as an amplifier, which they admitted was outside the invention in the patent. It was a grid valve used as an amplifier. Counsel also submitted that this patent as it stood to-day was invalid.

Mr. Courtney Terrell, on behalf of the de Forest Automatic Telephone Co. (also opponents), said the whole of the merit claimed in this case was the property, not of Fleming, but of de Forest. He appeared for the man whose clothes had been stolen in this case. Dr. de Forest, whose main patent—that was to say, the three-electrode patent—dated from 1908, was at the time when the renewal fees for these patents became due in extremely difficult circumstances, and he could not afford to pay the renewal fees. He allowed the patent to lapse, and after the patent had lapsed, and had become open to the world, they then suddenly saw an enormous development of the use of valves in this art, and the valves that were used were not Fleming's valves, but de Forest's valves. In continuous-wave telegraphy the three-electrode valve continued to be used.

Mr. Kelly, on behalf of the Controller, said he was of opinion that a prolongation ought not to be granted. What was here asked was to have the opportunity of levying an immense tax upon the public in the future. If this invention was of great public utility, why had it not come into general use? The answer was because it did not suit the Marconi Co., and there was no other answer. That there was sufficient merit in the invention had not been proved; neither had inadequate remuneration of the patentee been proved.

Mr. P. H. Pettifer, giving evidence, said he was in the employ of the Marconi Co. from May, 1912, to May, 1916, and during that period he was employed at the long-distance station of the company at Clifden, Co. Galway. In the receiving apparatus there no use was made of a Fleming valve. A carborundum crystal was used as detector, and after that a three-electrode valve.

Prof. C. V. Boys, F.R.S., said the specification of the 1904 patent of Dr. Fleming included the use of a bulb in which there was a hot cathode and a cold anode for the purpose of detecting high-frequency oscillations, such as they had in wireless telegraphy.

Mr. R. P. H. Graham, called for the de Forest Co., said he was employed by Government Departments for the purpose of research on the subject of wireless telegraphy. In the course of his experience he had never seen any practical application in wireless telegraphy of the Fleming invention as described in Fleming's specification.

Mr. Jas. Swinburne gave evidence for the Crown, and described the development and use of valves for the detection of oscillating electric currents.

Mr. Justice Sargant concluded the hearing of the evidence and arguments on Friday, December 13th, and gave judgment on Monday, the 16th, the case having occupied the Court for nine days. In giving judgment, he said that the case was of great commercial interest; the legal and scientific importance was much less, and the elaboration of the technical evidence appeared to be due to the fact that other proceedings in connection with this patent were pending. In one respect the claim of the specification was too wide, and an application to amend it was to be made; it was sought to extend the life of the patent with the limitation comprised in the amendment.

The objectors had failed to show that there was no subject-matter in the invention. It was a pioneer invention, and was one of considerable utility, but could not be regarded as epoch-making, or even in the first rank as regarded utility.

As to the remuneration received, the first item, actual cash profits on the sale of valves, was £8,500. As to the second item, shares received on sale of foreign rights to subsidiary companies, £1,200,000 share capital had been received for the company's Argentine patents in 1907, and £100,000 was to be received for other patent rights. Even if only 1 per cent. of the aggregate price was to be appropriated to the Fleming patent, over £13,000 had to be added to the petitioner's remuneration on this score alone. The third head of remuneration consisted of pending claims against the American Government and some of the Departments of the British Government—particularly the Post Office, the Admiralty, and the War Office.

The claims against the Admiralty and War Office were admitted to be very large, and arose from the extraordinary and unexpected use of valves of this kind on aeroplanes. The petitioners would be in a substantially better pecuniary position than they might have expected to reach had not the recent war resulted in so unexpected an enlargement of the field of use of their invention. In view of the foregoing estimate of the three heads of remuneration the petitioners could not be held to have established the case of inadequate remuneration. In the result, he dismissed the petition.

Scoular v. Notable Electric Co., Ltd., and Warner.

In the Commercial Court of the King's Bench Division, on December 9th and 10th, Mr. Justice Bailhache had before him an action brought by Mr. James Alexander Scoular, of Merton Road, Wimbledon, against the Notable Electric Co., Ltd., of Kingston Road, Merton Park, and Mr. F. Warner, of the same address, plaintiff claiming the sum of £300 balance of moneys which the plaintiff alleged was due to him for goods sold, work done, and materials provided.

Counsel for plaintiff said he understood the Notable Electric Co. was a limited company in which Mr. Warner had considerable interest. Mr. Warner was minded in 1917 to start a factory for the purpose of manufacturing electric lamps. Mr. Scoular, who had been familiar with the work for some time, was approached for the purpose of entering into a contract to equip the factory. Premises had to be obtained, and they were obtained ultimately by the defendant company at Merton.

Plaintiff's case was that in June, 1917, it was agreed that he should provide the defendants with an equipment for making drawn-wire tungsten filament lamps, which, when

the necessary hands had been trained properly, would produce an output of 1,000 ordinary lamps per day of ten hours, that the plaintiff should instruct the defendants' managers and employés to the best of his ability in the manufacture of the lamps, for a period not exceeding six hours per day, for three months, commencing June, 1917; that the defendants should provide all raw materials of suitable quality, including uniform drawn wires, and finished caps, and also good quality bulbs, and tubing necessary for the manufacture of the lamps, and that the cost of the equipment and instruction should be £2,000. Defendants had paid to the plaintiff on account sums amounting to £1,700, leaving a balance of £300 still due and owing to the plaintiff under the agreement.

Defendants alleged that the plaintiff did not complete his part of the agreement, failing to provide the defendant company with an equipment which when the necessary hands had been trained properly would produce an output of 1,000 ordinary 60-watt lamps per day of ten hours. It was alleged that the motor supplied by the plaintiff was incapable of doing the work required, and fired and became useless, that the gas fires fitted by the plaintiff to the machines were defective and insufficient and inadequate for the output required, and that the machines supplied were in such a condition as to continually break down and require repairing. Defendants counterclaimed for £1,637, the principal item being loss of profit on 42,000 lamps, being the difference between 64,000 lamps that the equipment should have turned out between November, 1917, and February, 1918, and the number of lamps actually turned out, 22,000—6d. per lamp, £1,050.

Witnesses were called on both sides, and counsel addressed his lordship, Mr. J. A. Hawke, K.C. for the defendants, and Sir Ernest Pollock, K.C., for the plaintiff.

Mr. Justice Bailhache gave judgment for the plaintiff for the amount he claimed, £300, with costs, and he gave judgment for the defendants for £435, with costs, on the counterclaim.

Breach of Mining Regulations.

In Ayr Sheriff Court a miner was fined £5 for having, in No. 4 Auchencruise Colliery (1) failed to keep five detonators issued to him in a suitable case, and having given them to a roadsman in the colliery, and (2) being the person authorised by the manager to fire shots electrically, and being provided with the electrical-firing apparatus, with removable handle, having failed to keep the handle in his personal custody.

Linsdell *v.* Paignton Electric Lighting Co., Ltd.

Before his Honour Judge Lush-Wilson, at Paignton County Court on Monday, Mr. William Linsdell, of the Cinedrome, Plymouth, sued the Paignton Electric Lighting Co. for £30 1s. 2d.—Mr. Hutchings, for the plaintiff, said the company supplied current at two prices, 7d. per unit for lighting and 3d. per unit for power, and the question in dispute was which charge should be made in the present case. Plaintiff offered 3d. per unit, but the defendants cut off the supply. Plaintiff lost two performances (for which damages were asked), and then paid at the rate of 7d., and now sued for the return of the money. There was a second supply to the operating room, where a much lower voltage was required for the arc throwing the light on the screen. Plaintiff contended that he should be charged at the power rate for the amount registered by the meter. The Electricity Acts were silent on the point.

The Judge: It is power, no doubt, but the ultimate result of that power is the production of electric light.

Mr. Hutchings replied that at Plymouth the plaintiff paid for the current as power.

Charles T. Instrell, an electrical engineer, said the current was used to excite, or cause to revolve, the field magnets.

Mr. Kenny (for the company): Does any part of the current supplied at 440 volts communicate with the arc lamps?—No; there is no contact direct with the arc lamps.

Mr. E. W. Jeffs, an expert, said there were two different sets of windings, the primary and the secondary, and the current supplied to the former caused or excited the motion in the other, which generated current.

The Judge: There is no junction or connection?—Witness replied, no. At Plymouth and Dartmouth, where the same thing existed, current was charged as power.

The Judge regarded it as a nice point involving a mixture of fact and law which he should not like to settle by himself. He adjourned the case to allow of the parties agreeing upon an electrical arbitrator.

Workmen's Compensation.

At the Bow County Court, on Tuesday, an application for a new trial was made to Judge Graham, K.C., in the action already reported (Elec. Rev., December 13th) in which T. E. Knight, of 7, Cooper Street, Canning Town, an engineer, was awarded £75 damages for personal injuries against the Charing Cross, West End & City Electricity Supply Co., Ltd. The application was on the ground that the verdict was against the weight of evidence. The defendants alleged that the jury found that the negligence was in not having put up a fence until afterwards, and they would like to call evidence to prove that no such fence had been put up, nor was it necessary.

Judge Graham said he could see no ground for the application, and said the verdict must stand.

Allowance was then asked for for the £5 which the plaintiff had been paid under the Workmen's Compensation Act, to which he agreed, and the amount was reduced to £70. Leave for stay with a view to an appeal was then asked for, but his Honour refused it, saying he would have acceded to the request had there been the slightest chance of the defendants' success, but there was none.

BUSINESS NOTES.

The Christmas Holidays.—We shall be glad if our readers will take note that, owing to the Christmas Holidays, the Electrical Review for December 27th will have to be printed two days earlier than usual. All matter intended for that issue, whether editorial or advertisement, should be in our hands at the earliest possible moment. All new advertising copy and alterations to existing displayed advertisements must be received here not later than this morning, Friday, December 20th. Official Notices and small prepaid advertisements can be received up to Tuesday morning.

Trading with the Enemy.—The *London Gazette* for December 13th contains further lists of persons and bodies in the following countries with whom trading is prohibited:—Paraguay, Brazil, Chile, Guatemala, Honduras, Mexico, Morocco, Netherlands, Netherland East Indies, and Spain.

Canadian Trade.—A Canadian Trade Commission has been appointed to co-operate with the Canadian Mission in London with a view to securing a share in reconstruction work in France and Belgium, and to develop Canadian export trade. Sir Charles Gordon, Mr. C. B. Macnaught, and Mr. H. B. Thompson compose the Commission.—*The Times.*

Agreement Between German Employers and Trade Unions.—An agreement has been arrived at between the German Employers' Associations and the Trade Unions. The text of the agreement, which consists of 13 clauses, is given in *Soziale Praxis* (November 21st), as follows:—

1. The Trade Unions are recognised as the competent representatives of the working classes.

2. No restrictions may be placed upon the right of the workers, of both sexes, to combine.

3. The employers and Employers' Associations will, for the future, refrain from any interference with the Labour Associations—the so-called economic Peace Associations (Wirtschaftsfriedliche Vereine), and will not support them either directly or indirectly.

4. All workers returning from military service are entitled, after giving due notice, to be reinstated at once in the posts they occupied before the war. The employers and Employers' Associations must endeavour fully to comply with this obligation by procuring raw material and orders.

5. Labour Bureaux must be ruled and administered by equal numbers of employers and workers.

6. Labour conditions for all workers of both sexes are to be determined in accordance with the circumstances of the industry concerned by mutual agreements with the trade associations of the employés.

7. In each business establishment employing at least 50 hands a Workers' Committee is to be appointed, which will represent the workers, and, in conjunction with the owners of the establishment, see to it that the labour conditions in the establishment are regulated in accordance with the mutual agreements.

8. The mutual agreements must provide for Arbitration Committees or Conciliation Boards, composed of equal numbers of employers and workers.

9. The maximum regular daily working time in all business establishments is fixed at 8 hours. No reduction of wages consequent upon this curtailment of working hours is permitted.

10. In order to carry out this agreement the employers' and workers' Associations will establish a Central Committee on the basis of equal representation, to which special members of the trade will be attached, for the purpose of regulating the measures necessary for demobilisation, for the maintenance of the economic position, and for securing for the workers, especially those severely injured in the war, the possibility of existence.

11. The Central Committee will also be responsible for the settlement of fundamental questions such, for example, as arise from the mutual regulation of wage and labour conditions, as well as the settlement of disputes, which affect various trade groups at the same time.

12. The decisions of the Central Committee are binding for both employers and workers unless they are challenged within seven days by one of the two trade Associations concerned.

13. This agreement comes into force on the day on which it is signed, and remains valid, in default of other legal regulation, until further notice, subject to three months' notice by either party.

This agreement, in its general purport, is also to govern the relations between the Employers' Associations and the Associations of Clerks.

The Holidays.—Messrs. Higgs Bros., of Birmingham, are closing their works and offices from Tuesday night until the following Monday morning.

Messr. J. H. Tucker & Co., Ltd., Birmingham, are closing their works and offices from Tuesday evening until the following Monday morning, 30th inst., for the Christmas Holidays.

Federation of British Industries.—This Federation has issued a full report of 30 pages, of the proceedings, including the resolutions passed, at the second annual general meeting held in London in October. We have already published a necessarily abbreviated account of the proceedings, but those who want the complete report should apply for a copy of this document (39, St. James' Street, London, S.W. 1).

The Coming Boom.—The following review of the situation appeared in the *Engineer*, last week, from our contemporary's always interesting correspondent at Sheffield:—"Things in this industrial centre are certainly beginning to assume more definite shape regarding reconstruction. . . . . It is really too early to expect definiteness, yet it is clearly manifesting itself. Perhaps the most important direction this manifestation is taking is towards the reconstruction of labour staffs; at least, it seems to me the most important at the moment, because no headway can possibly be made until the labour dislocation period has been safely negotiated. That it is being negotiated cannot be gainsaid. The operation is taking almost a normal course. This is a surprising promise of a rapid recovery when all the circumstances are remembered. The general forecast of the early post-war days included a certain period of unemployment before anything like an industrial boom could be entered upon. Instead of that, there is in this area already a pressing demand for men, especially for skilled and semi-skilled workers, and for the present it looks as if the available supply is seriously deficient. It means that the peace-trade boom is already leaving the slips, and will take the water long before many thought it possible. Two hindrances to more rapid progress are the general election and the coming Christmas holiday. The workers are preparing to keep the latter in a way which has been impossible to them since the Christmas of 1913, and it is being freely stated that many firms intend closing their works for a full week or even longer. It may, therefore, be taken as certain that the trade boom will not be actually launched until the early days of 1919. In the meantime the important work of reconstructing labour staffs is proceeding satisfactorily up to a certain point. Men who came to the Sheffield district from other callings and towns are departing. Colonials who came over to augment engineering staffs, when such help was vitally needed, are booking their passages home again. Belgians are seeking repatriation. Shopkeepers whose knowledge of lathe-work gained during the war is quite passable in a crowd, are returning to reconstruct their businesses. Sheffield men who, under the National Service system, were drafted away to various munition-making centres, are coming back. But the point at which difficulty is experienced is the pressing need now for the return of the skilled men—or those of them who survive and are fit—who left in large numbers for the Colours in the early days of the war. They ought never to have been allowed to go, as their services were needed badly at home, and the question with which employers are confronted now is whether the demobilisation of 'pivotal' men, and the release of thousands of skilled and semi-skilled young men who were demanded by the military authorities in more recent days will take place in time to permit this labour staff reconstruction to be completed early in the new year, or to a sufficient extent to allow the coming trade boom to develop unhindered. Demobilisation is a big problem, and if it is found by experience that, though launched, the boom cannot be made ready for sea for a few months, that fact must be borne in mind."

Boiler Orders Revoked.—The Minister of Munitions has revoked the Boilers Returns and the Boilers Control Orders which provided respectively (*a*) for the making of certain returns; and (*b*) that no person except with a permit might purchase, sell, or deal in any second-hand steam-pressure boiler other than boilers for use in locomotives, motor-cars, vehicles, or ships. The Order did not, however, authorise dealing in boilers for which a permit is required under the Railway Material (Second-Hand) Order, 1916.

Reconstruction Problems.—The Ministry of Reconstruction has now issued No. 8 of its series of pamphlets. It deals with the "Re-settlement of Civil War-Workers," and discusses such matters as the demand for labour, new openings for labour, the Re-settlement Department, measures of re-settlement, measures for extending existing employment, the release of munition workers and the terms of unemployment remuneration.

Stocks of Non-Ferrous Metals.—In order that the trade may know the position in regard to stocks of the important metals, the following particulars are published of the stocks (exclusive of old metal and scrap) in this country in the possession of the Minister of Munitions on December 1st, 1918, viz.:—

Copper	27,580 tons.
Spelter G.O.B.	18,768 "
" Refined	6,544 "
Aluminium	10,115 "
Soft pig lead	49,111 "
Nickel	1,745 "
Antimony regulus	3,903 "

It is intended to publish, at monthly intervals, the stocks held on the first day of each month. In addition to the above, the Minister holds large quantities of scrap, mainly brass, of which it is impossible to give any figures at present.

For Sale.—Hackney B.C. electricity department invites offers for 393 10-ampere open-type arc lamps and about 13,000 solid and 11,000 cored carbons. Particulars are given in our advertisement pages to-day.

Catalogue Standardisation.—According to the *Board of Trade Journal*, the National Association of Purchasing Agents of the U.S.A. has finally adopted two sizes for all catalogues and booklets—namely, 7½ in. × 10¾ in. and 5½ in. × 7½ in. The Graphic Arts Section of the Canadian Manufacturers' Association has also approved a table of standard sizes for catalogues and booklets.

German Demobilisation.—According to the *Kölnische Zeitung* (November 18th), the first men to be released from the German Army are workers and employés connected with the means of communication (railways, shipping, tramways, &c.); then those connected with power stations (electric, gas, and water-power). This measure does not imply any special preference shown to these particular men, but is to the advantage of every soldier, as it will facilitate his return home.

The Formation of Whitley Industrial Councils.—In a publication issued by the Ministry of Reconstruction there is given a list of industries in which industrial organisations have been formed along the lines of the Whitley Report. In addition to the Joint Industrial Councils (J.I.C.) already set up, there are also 29 Interim Industrial Reconstruction Committees (I.I.R.C.) at work, some of which are reaching the stage at which they will soon be convertible into full Joint Industrial Councils. We give below a selection of industries in which organisations have been established, and the names and addresses of secretaries:—

Brass and Copper Trades (I.I.R.C.) (Provisional).—Liaison Officer: F. W. Raffety, Ministry of Reconstruction.

Building (J.I.C.).—Secretaries: Employers, A. G. White, 48, Bedford Square, London, W.C. 1; operatives, W. Bradshaw, 15, Union Street, Ardwick Green, Manchester. Liaison Officer: A. L. Dakyns, Ministry of Labour.

Cable-Making (P.D.C., J.I.C.).—The Secretary, Provisional Drafting Committee, Ministry of Labour.

Commercial Road Transport (P.D.C., J.I.C.).—The Secretary, Provisional Drafting Committee, Ministry of Labour.

Electrical Contracting (P.D.C., J.I.C.).—The Secretary, Provisional Drafting Committee, Ministry of Labour.

Electric Power and Supply (P.D.C., J.I.C.).—The Secretary, Provisional Drafting Committee, Ministry of Labour.

Glass (I.I.R.C.).—Major Hazzledine (*pro tem.*), Board of Trade, 1, Horse Guards Avenue, S.W. 1.

Iron and Steel Trades (Commercial Committee).—Mr. N. H. Deakin, O.B.E., Sheffield Telegraph Buildings, High Street, Sheffield. The work of this Committee will be limited to commercial and technical questions.

Railway Carriage and Wagon Building (I.I.R.C.).—Sir W. B. Peat, 11, Ironmonger Lane, E.C. Liaison Officer: F. W. Raffety, Ministry of Reconstruction.

Tramways (P.D.C., J.I.C.).—The Secretary, Provisional Drafting Committee, Ministry of Labour.

Wire Manufacturing (I.I.R.C.).—J. W. Wyatt (*pro tem.*), Ministry of Reconstruction.

Zinc and Spelter (I.I.R.C.).—F. W. Raffety (*pro tem.*), Ministry of Labour.

Calendar.—The Superheat Furnace Co., Ltd., Bradford, has issued a wall calendar with a block of daily slips for 1919.

Strike Troubles at German Electrical Works.—The Hague correspondent of the *Times* says that in response to Liebknecht's appeal for a general strike, 54,000 men at Siemens's works threatened to come out, but abandoned their intention through Herr Barth's intervention. The workers' officials, it appears, made such demands as would have rendered the firm's continuance impossible. It is also stated that at Bergmann's electrical works at Rosenthal, differences occurred between workers and the managers, but the differences were adjusted. On Friday last, however, Liebknecht entered the building by force, and persuaded the workers to attend a meeting, after which they did not return to work. At other places men are threatening to destroy the mines and to sink all merchant ships unless their demands are granted.

The *Daily Mail* prints dispatches in the course of which it is stated that the demands made by the workers in various factories have been on a most ambitious scale, meaning nothing short of ruin. The head of "one of the largest companies in the electrical industry in Berlin," who has to do "with highly-educated workers," said that demands amounting to £2,000,000 had been made to him, which far exceeded the company's revenue.

In one case at Leipzig a supplement to wages from August 1st, 1914, was demanded at a works employing 700 persons, which meant that the proprietor must lay on the table £85,000 to satisfy the demands of the moment. Thousands of pounds were to be paid in coin, and the stipulations for the future included one for a full month's salary as a Christmas-box.

In the Electrical Review for August 30th we discussed the reductions of wages that were being made in some of the German factories, including one of the branch works of the Siemens-Schuckert Co. In referring to the big war profits of the German firms which they had put into reserves in German War Loan for after-war trade, we remarked: "If the German workers' claims for war profits to be disgorged were to become general, there would not be even those depreciated 'scraps of paper' left."

Concert.—The electrical employés of MESSRS. HIGGS AND HILL, LTD., contractors, will hold a concert at the Crown Works Canteen, South Lambeth Road, S.W., on Saturday, December 28th, at 7 o'clock.

Non-Ferrous Metal Industry Act.—A further list of licences granted under this Act appears in the *London Gazette* for December 17th.

Pivotal Mining Men.—We read in a financial daily that the Institution of Mining and Metallurgy has been appointed by the Ministry of Labour as the central authority for the demobilisation of pivotal men connected with metalliferous mining and non-ferrous metallurgy.

Bankruptcy Proceedings.—WILLIAM T. SMITH, electrical and mechanical engineer, Victoria Street, and 60, Hampden Street, Bolton.—This case was again mentioned at Bolton to the Registrar on 11th inst. It had previously been adjourned to enable debtor to carry out his desire to make an amended composition for an increased amount. An application was now made for the extension of the adjournment to March 12th. The Registrar agreed.

E. CULL, electrical fitter. "formerly licensed victualler," Plymouth.—Trustee, Mr. A. N. F. Goodman, released November 28th.

E. CLONEY, tramway divisional superintendent, 5, St. Albans Road, Parliament Hill Fields.—Receiving order discharged conditionally.

A. MATSON, lately electrical engineer, Stockton-on-Tees.—Application for discharge to be heard at Stockton-on-Tees, January 14th, 1919.

S. SMITH (Smith & Sons), "music and musical instrument dealer, electrical engineer, and general dealer," Widnes. — Discharge suspended for two years.

Italian Company Notes.—Under the auspices of the Gouppo Quartieri (S.T.P.E.) there has been established at Milan the Fabbrica Italiana Apparechi e Materiali Elettrico, with a capital of 1,500,000 lire.

By the issue of 2,655 shares the Società Telefonica Cisalpina, of Bergamo, has increased its capital to 750,000 lire.

The Società Elettrica Sarda, of Leghorn, has increased its capital to 10,000,000 lire, and shifted its headquarters to Milan. This company works in conjunction with the Società Elettrica de Tirso.

By the issue of 3,000,000 bonds the Società Varesina per Imprese Elettriche, of Varese, has augmented its capital to 12,325,000 lire.

The Società Anonima Materiali Elettrico, of Milan, has increased its capital to 450,000 lire, and the Adamello Co. from 20,000,000 to 30,000,000 lire.

Italian Machine Tool Trade.—The provision of machine tools for their expanding industries after the war is exercising the minds of prominent Italians. One-tenth of these imports before the war were supplied by England, three-tenths by America, and six-tenths by Germany. The last-named country will, however, cease to count among Italy's suppliers, and her requirements will have to be met elsewhere. To this end a company was recently formed at Milan under the style Associazione fra gli Importatori di Machine Utensili, which, pending the time when Italy is able to provide for her own wants, will control the business of machine tool imports, among which agricultural motors and machinery take a leading place.

Trade Announcements.—During the war the lowering-gear business of the LONDON ELECTRIC FIRM has been carried on to a considerable extent, mostly for munitions and similar factories. The firm's operations, however, have been mainly devoted to searchlights for various Government Departments—the War Office, the Admiralty, the Air Board, &c. They will now continue with their lowering gear, winches, wire rope, pulleys, &c., also searchlights of Army, Navy, mercantile, canal, Fire Brigade, and yacht types. They are also making machines with electric, pneumatic, hydraulic, and rod-distance control, parabolic and other mirrors, combined auto and hand-feed lamps, &c.

THE STANTON IRONWORKS CO., LTD., near Nottingham, have entered into a working arrangement with Messrs. James Oakes and Co., of Alfreton Ironworks, Derbyshire, under which the Stanton Co. will, from January 1st next, act as sole selling agents for the products of Messrs. Oakes's blast furnaces and foundries.

Liquidations and Dissolutions. — LARNE ELECTRIC LIGHT WORKS, LTD.—Winding up voluntarily: Liquidator, Mr. J. D. A. Norris, Suffolk House, Laurence Pountney Hill, E.C.

HERRTAGE, LESTER & CO., electrical engineers, 4, Queen Street Place, E.C.—Mr. S. E. Herrtage and Mr. G. W. Lester have dissolved partnership. Mr. G. W. Lester will continue the business under the same style at the old address.

THE JOHNSON SECRET WIRELESS TELEGRAPH AND TELEPHONE TESTING SYNDICATE, LTD.—Meeting January 18th, 1919, at 2 and 3, West Street, E.C., to hear an account of the winding up from the liquidator, Mr. J. A. Robertson.

ACCUMULATOR SERVICE CO., 7 and 9, Station Approach, Wanstead Park Station, Essex.—Messrs. S. T. Jolley & A. H. Knight have dissolved partnership. Debts will be attended to by Mr. S. T. Jolley, who will continue the business.

Exports to China.—The *London Gazette* for December 17th contains additions to the list of persons and bodies in China to whom exports may be consigned.

Coal and Industry.—At the adjourned meeting of the Federation of British Industries, a resolution was passed setting forth the Federation's ideas regarding Peace Aims. Other resolutions included one as follows concerning coal supply:—"That the position of industry with regard to priority of coal supply is a serious menace to employment and the speedy conversion from War to Peace production; and that the War Cabinet should take the matter into consideration immediately."

Catalogues and Lists.—BRITISH THOMSON-HOUSTON CO., LTD., Mazda House, 77, Upper Thames Street, E.C. 4.—New price list No. 10,401—10 A and 10 B, showing the new type of "Efracta" lantern and the light-distribution curve.

MESSRS. MAVOR & COULSON, LTD., 47, Broad Street, Mile End, Glasgow.—Leaflet particularising C.C. generator and motors held in stock.

MESSRS. PLAISTOWE & CO., LTD., Wharfdale Road, King's Cross, London, N. 1.—Leaflet relating to "Nettol," a cold-water preparation for cleaning machinery, varnished surfaces, &c.

Belgium and German Goods.—There is an important and influentially-supported movement on foot in Brussels for preventing the employment of manufactures of German origin in future commercial enterprises in that city. Our readers know well enough to how large an extent German industrial and financial concerns had worked their way into Belgian affairs before the war. In Belgium the beast has left its trail wherever it has passed, and the determination to prevent repetition of former penetration and commercial domination will be as strong there as in any other country. But the Belgian electrical men have not concealed their anxiety regarding future possibilities if England or the Allies are unable to meet requirements. Precisely the same fear was expressed at different periods of the war by Russian engineers in regard to Russia's vast needs. The call to England, the United States, and other exporting countries is loud, and the penalty of ignoring it will be to throw both Belgium and Russia into the arms from which they shrink. There is a need for a large co-operative effort on the part of the manufacturing concerns of Allied countries in dealing with the situation. The decision arrived at by the College of Aldermen at Brussels is that a clause shall be inserted in the conditions of contracts for commercial enterprises in the city providing that no product of German origin shall be employed therein, and that any infraction of this regulation shall be punished by the forfeiture of 25 per cent. of the total amount involved. The Alderman of Public Works has issued a notification discountenancing the reopening of business relations in any form with enemy nations; but he goes even further, and adds, "or with nations which have been working in the enemy's interests." Such a decision gives the manufacturers of this and Allied countries an opportunity for trade and work that should not be missed.

Book Notices.—*L'Electricité.*—Under this title a new electrical journal is about to be inangurated in France, to fill a gap which at present appears to be open. The existing publications—excellent of their kind—are over the heads of the less highly trained engineers and electricians, and it is to serve the needs of this class that our new contemporary is designed—to provide technical and commercial information for electrical workers, and for those who are not electrical specialists. Being tied to no sectional or financial interest, *L'Electricité* will have a free hand to deal with all questions on their merits, and will play its part in promoting the expansion of the French electrical industry; it will be directed by our esteemed *confrère*, M. J. B. Nouet, formerly commercial manager of *La Lumière Electrique*, and *La Revue Générale de l'Electricité*, to whom we wish all success. The foreign subscription will be 25 fr.; address, 2, Rue de la Pépinière, Paris.

"*Proceedings* of the Physical Society of London." Vol. XXXI, Part 1. December 15th, 1918. London: Fleetway Press, Ltd. Price 4s. net.

"Science Abstracts." Vol. XXI. Part XI. November 30th, 1918. Sections A and B. London: E. & F. N. Spon, Ltd. Price 1s. 6d. net each.

LIGHTING AND POWER NOTES.

Arbroath.—STREET LIGHTING.—After considering the changes in connection with electricity supply foreshadowed by the Government, the E.L. and Power Co. has inquired whether the Council desires the electrical street lighting to continue, as the company has a favourable opportunity of disposing of its standards, lamps, and apparatus. The Council has asked the company on what terms it will carry on the street lighting, on the basis of the 50 per cent. now allowed.

Australia.—E.L. SCHEMES.—The following municipalities are considering the question of installing electricity schemes within their areas:—Bland (N.S.W.) Shire Council; Junee (N.S.W.); Millicent (S.A.); St. George (Q.); Penguin (Tas.); and Ithaca (Q.). The Elmore E.L. and P. Co. has received permission to install electricity at Elmore (Vic.). The Mirboo North Dairy Co. has decided to supply the town of Mirboo with electricity. The Cessnock (N.S.W.) Shire Council has entered into an agreement with the Hetton Coal Co. to install electricity at Bellbird.

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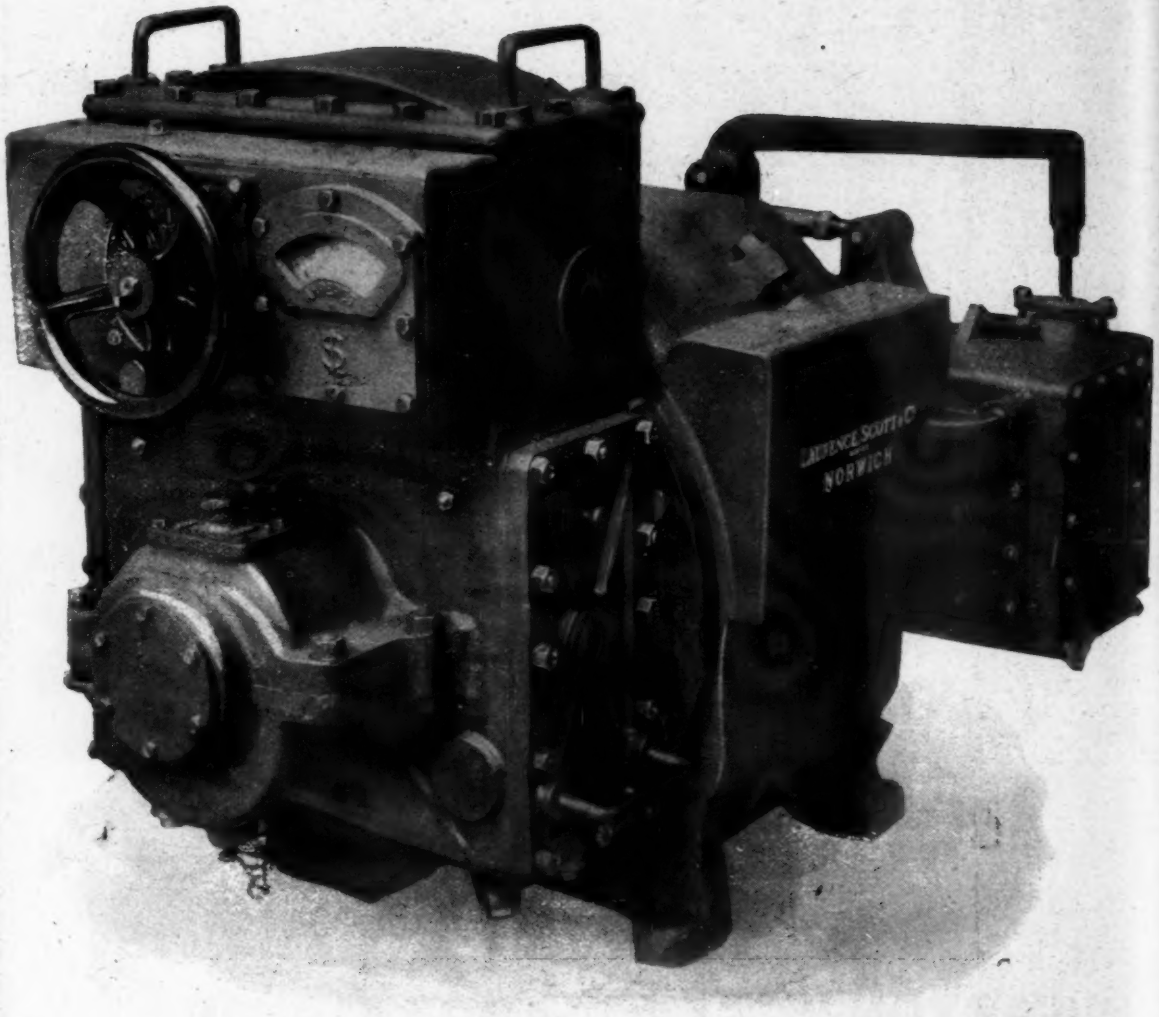

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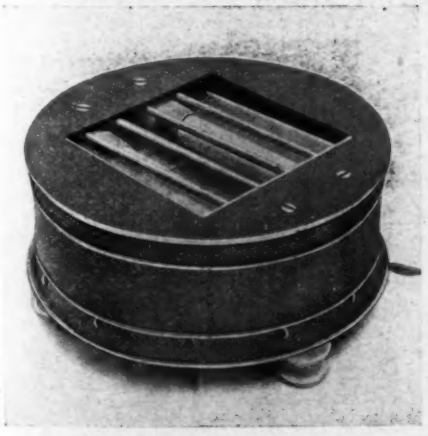

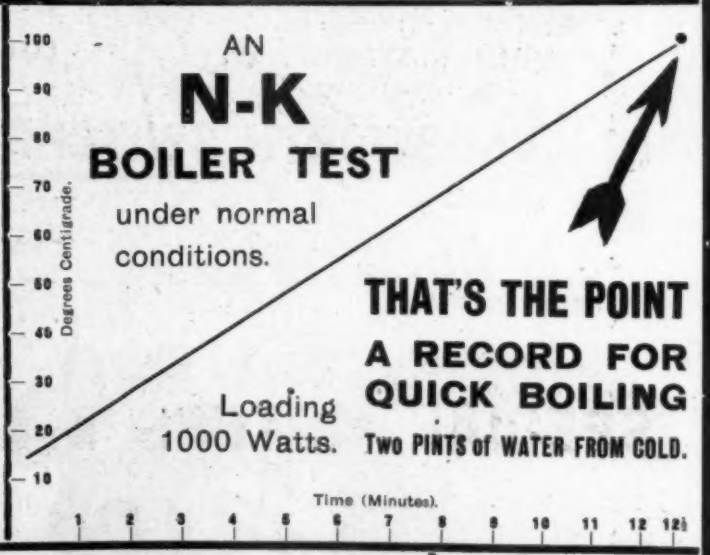

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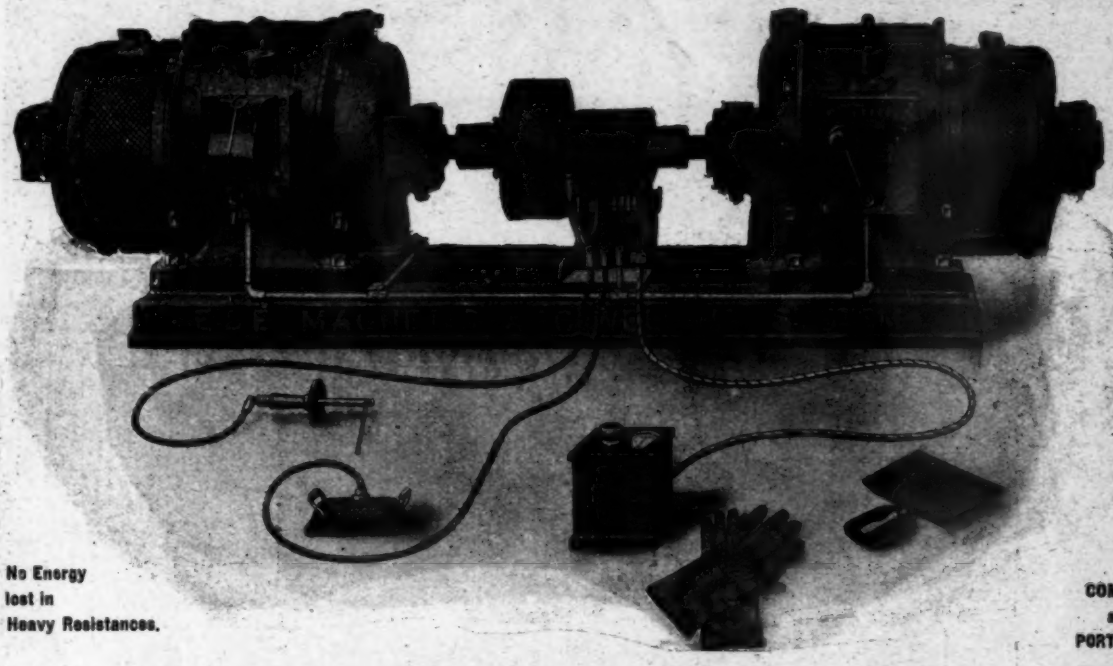

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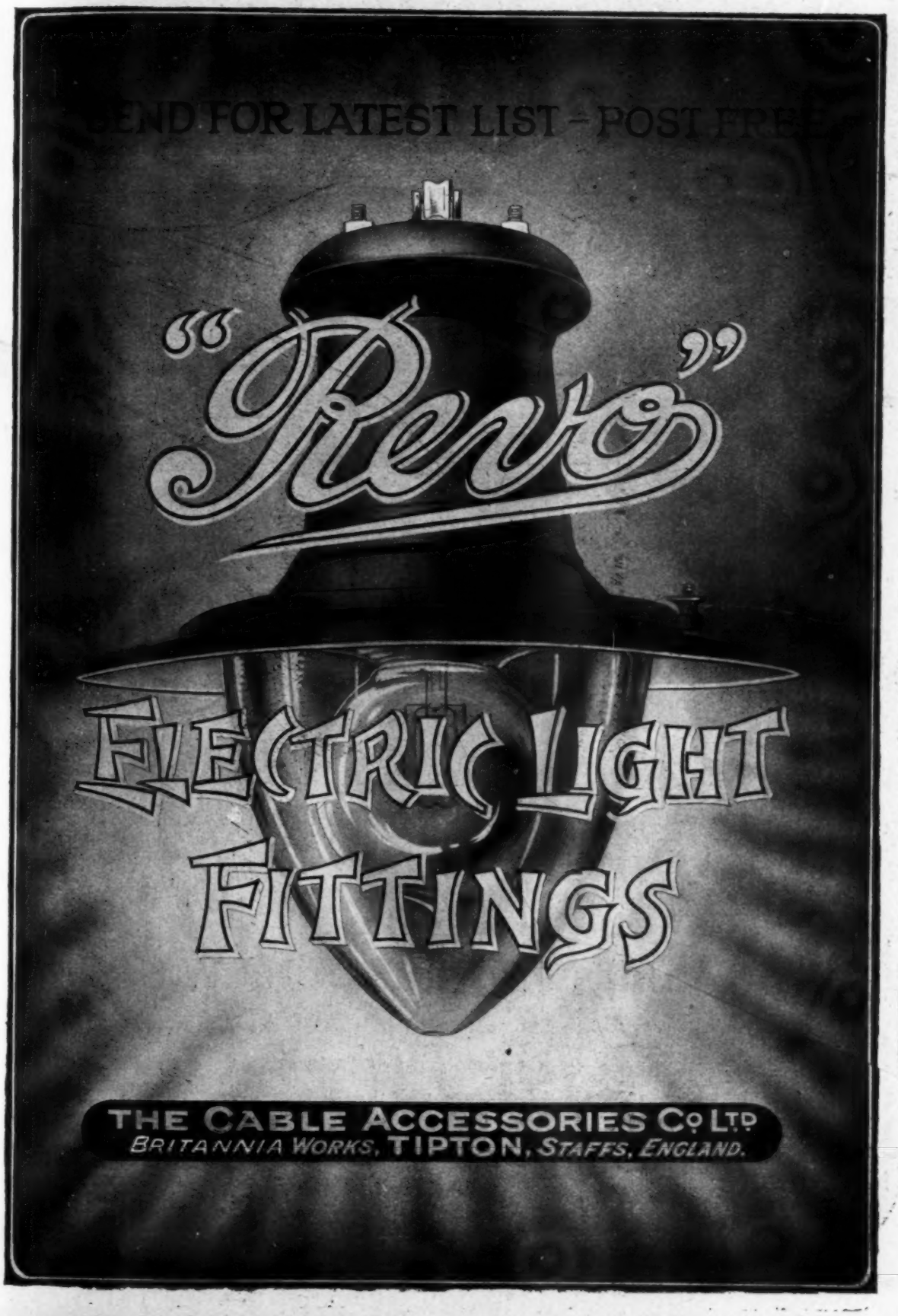

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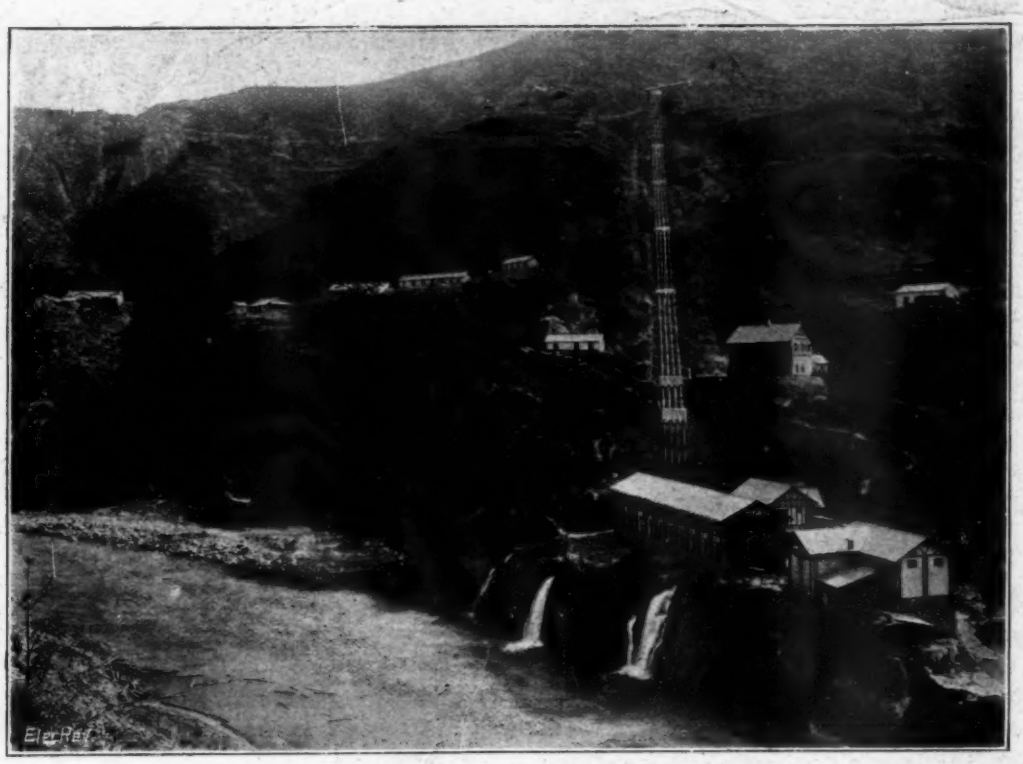

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can be at once started at work, when the restrictions on new connections are cancelled.

This again would create a demand for Wiring Accessories, Meters, Light Fittings, Heating and Cooking Appliances, Dynamo Machinery, and in fact every class of Electrical Manufactures.

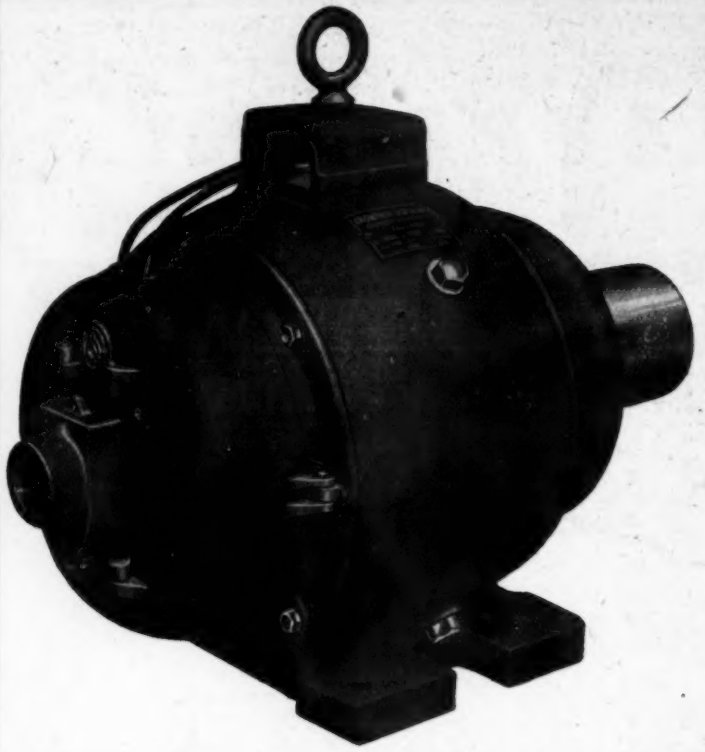
The Industry, in a word, would be re-vitalised. Employment would be found for many thousand more demobilised soldiers in the Electrical Factories.

Coal would be saved and railway congestion lessened all the time.

Are you writing to the Ministries concerned, pressing these points home?

Immediate delivery can be given of Belling Fires and Cookers.

Our present prices are 50 per cent. above our pre-War prices, and as long as wages remain at their present standard (and they will probably never drop again), our present prices will remain constant with them. Belling & Co., Edmonton, London, N. 18.



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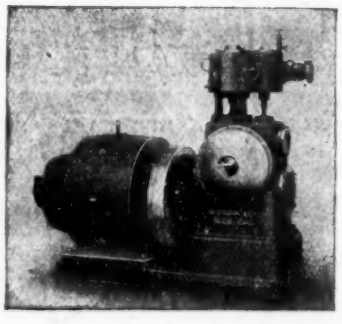

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You'll have perfect transmission *always* once you adopt Ferodo friction surfaces. "Idle moments" will be reduced to a minimum—output will be greatly increased.

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STERLING TELEPHONES for every purpose,
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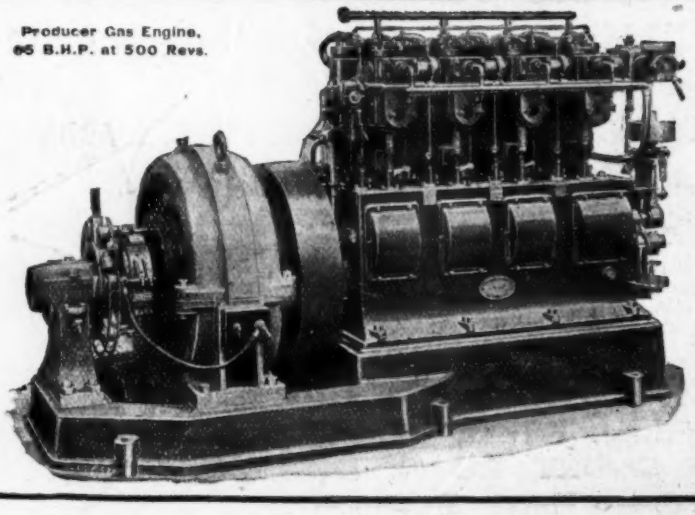

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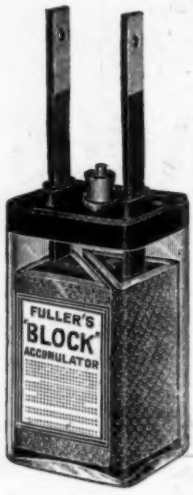

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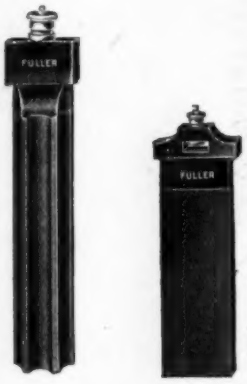

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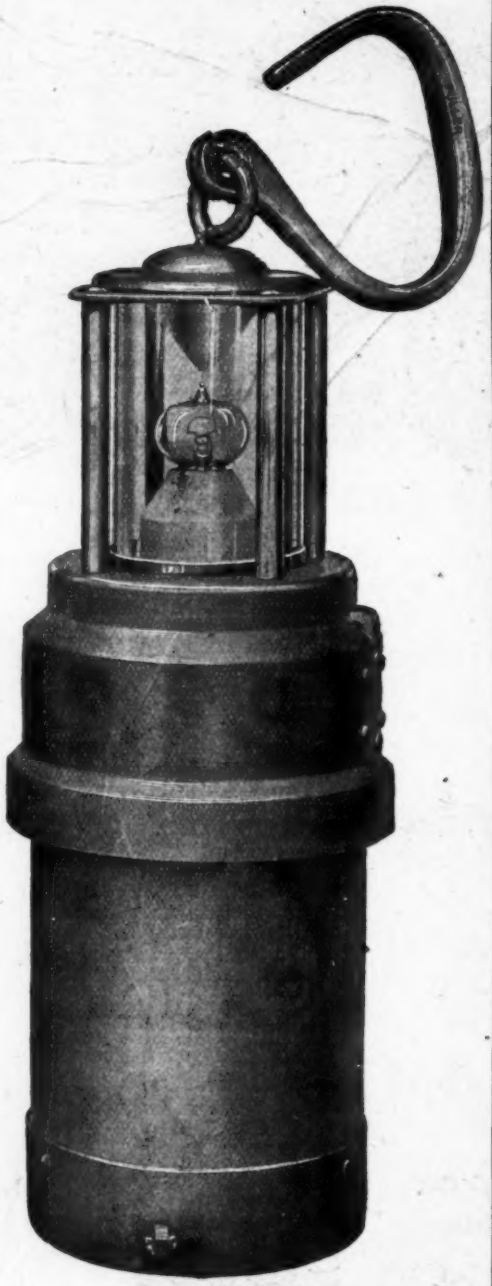

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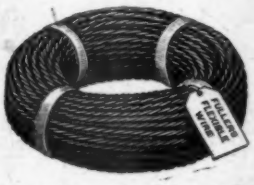

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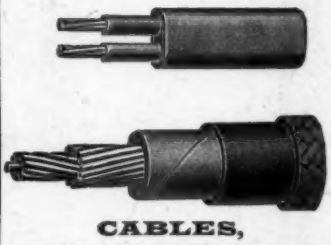

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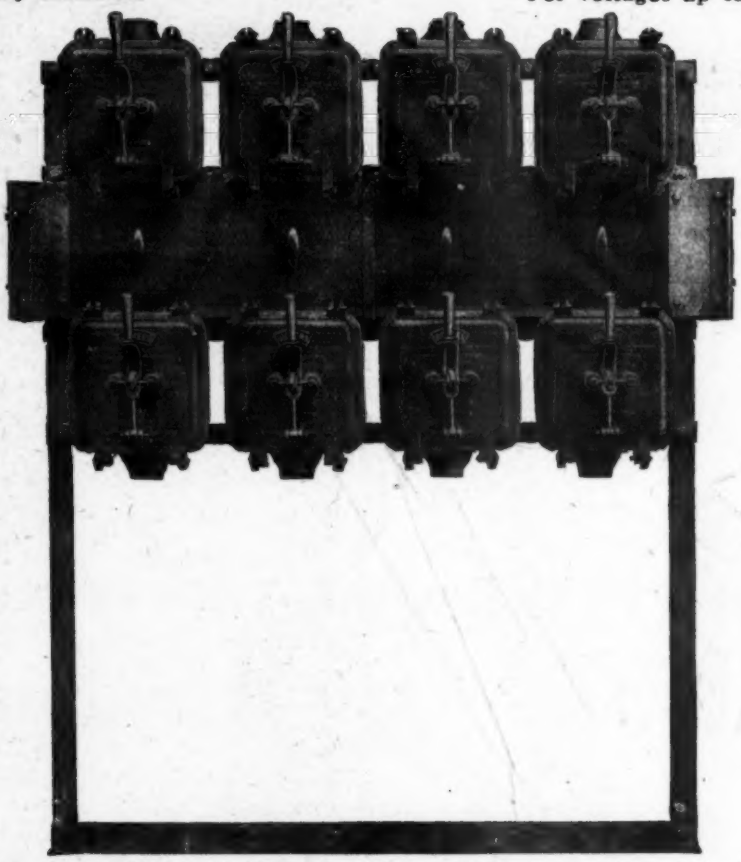
Totally enclosed. **For voltages up to 500.**



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MIDLANDS: Bill & Berry, 18 to 26, Constitution Hill, Birmingham.
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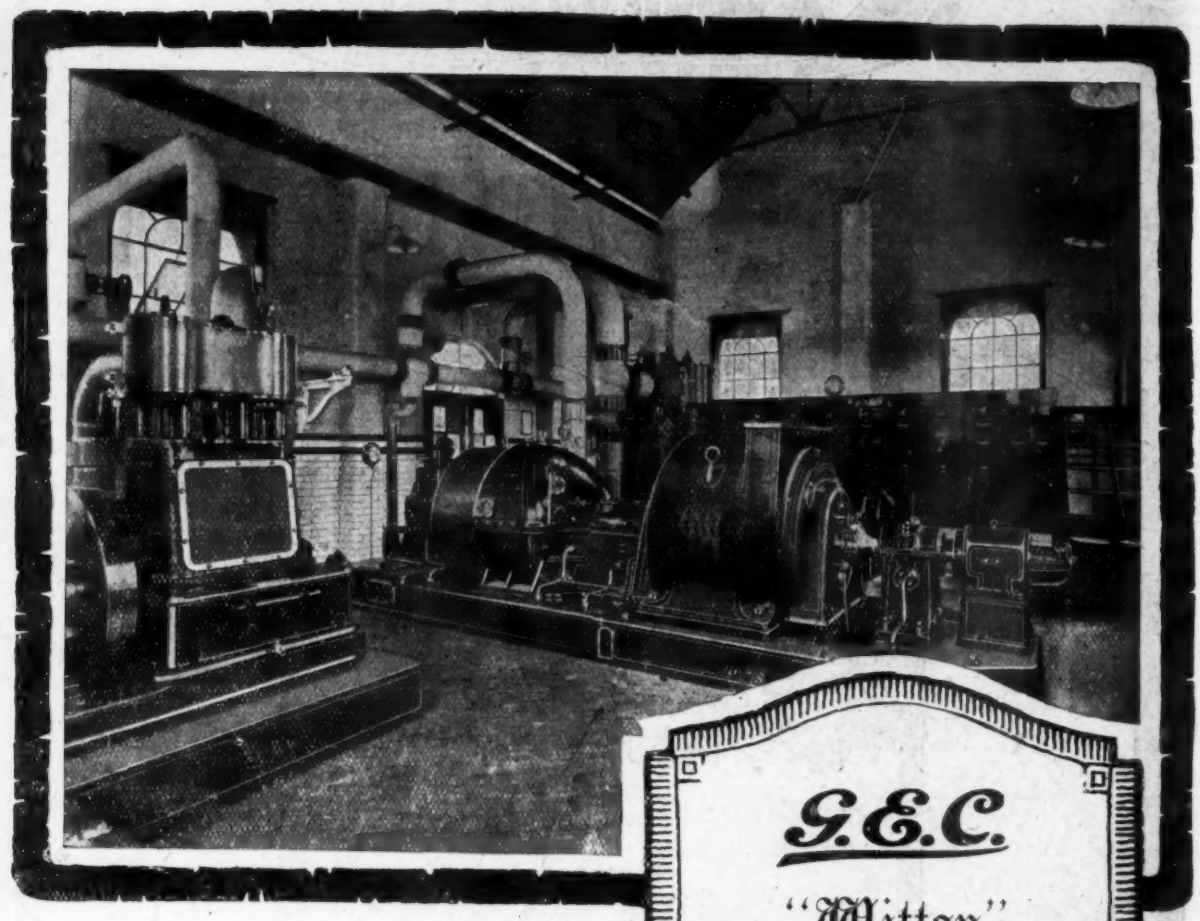

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CHRISTMAS HOLIDAYS

Our Issue of the 27th inst.

IMPORTANT NOTICE TO ADVERTISERS

Advertisers will please note that NEW COPY and ALTERATIONS to existing displayed Advertisements must reach here

Not later than Friday Morning, the 20th.

Official Notices — and — Small Prepaid Advertisements can be received up to 9.30 a.m. on TUESDAY the 24th.

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Unless otherwise instructed, **ALL LETTERS** received in answer to Advertisements with a Box number, **ARE FORWARDED NIGHTLY.** Postages incurred are charged at cost

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SITUATIONS VACANT.

Latest time for receiving 9.30 a.m. Tuesday.

If letters are not to be delivered to certain firms or individuals (if known), instructions to that effect should be sent to the Manager of the ELECTRICAL REVIEW, who will do his best to carry out such instructions. Letters of applicants cannot in such cases be returned to them, nor can the names of Advertisers using a number in any way be disclosed.

Original Testimonials should never be sent.

WORKING ELECTRICIAN.

WORKING ELECTRICIAN wanted to take charge (except driving) of a 125-kilowatt station with power plant driven by same and which will probably be extended soon. Trained experienced electrician and mechanic required who must have good knowledge and experience in the repair and maintenance of electric motors and must be a capable winder of dynamo and motor armatures and coils. He must also have a good practical knowledge and experience of gas engines, as he will be responsible for the upkeep of these on the station.

Apply, stating age, wages required, and enclosing copies of three recent testimonials.

Required to take up duties immediately.

3345, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

KENT EDUCATION COMMITTEE.

ERITH TECHNICAL INSTITUTE.

Principal, Wm. Neagle, B.Sc., A.M.I.M.E.

REQUIRED, full-time Assistant to teach Electrical Engineering and Mechanics.

Initial salary up to £250, according to qualifications, and thence by scale, now under the consideration of the County Committee.

Service counts towards pension under the Teachers' Pension Act.

Further information and application forms from A. T. FLUX, Esq., Education Office, Picardy, Belvedere, Kent.

E. SALTER DAVIES,
Director of Education.

December, 1918. 3521

SITUATIONS VACANT.—*Continued.*

COUNTY BOROUGH OF WOLVERHAMPTON.

Electrical Engineer's Department.

APPLICATIONS are invited for the position of Distribution Superintendent in the above department.

Candidates must have received a thorough technical training and had experience in the construction, control and maintenance of extra high tension and low tension mains and networks, rotary and static sub-stations, the installation of wiring, and industrial machinery, and the maintenance and repair of motors and other apparatus.

It is necessary for applicants to have proved abilities in the organisation of an outside department, and the efficient control of men.

Applicants must not be less than twenty-five years of age.

Salary £300 per annum.

Applications made on the form, which, with list of duties, may be obtained from the undersigned, to be delivered in envelope, endorsed "Distribution Superintendent," addressed to the CHAIRMAN OF THE ELECTRICITY COMMITTEE, c/o Town Clerk, Town Hall, Wolverhampton, on or before the 10th JANUARY, 1919.

S. T. ALLEN,
Chief Engineer and General Manager. 3670

POWER STATION FOREMAN.

POWER STATION FOREMAN wanted, East London. Responsible under Superintendent for all maintenance and new construction work. Must be able to control skilled and unskilled labour, check contractors work, and must have had practical experience with maintenance of modern land power plant, engines, turbines, water-tube boilers, usual coal and water auxiliaries and electrical repairs. Early morning man, living within easy access of works. Present salary, including current war wages, about £350 per annum.

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SHEFFIELD CORPORATION.

Ewden Valley Water Works.

WANTED, Electrician-Wireman accustomed to D.C. motors and lighting.

Apply GENERAL MANAGER, Town Hall, Sheffield. 3628

SWITCHBOARD ATTENDANT.

SWITCHBOARD Attendant required for Generating Station in London area; able to handle alternators and rotaries; wages, including bonus, &c., to date £3 18s. per week.

3675, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

(Continued on next page.)

SITUATIONS VACANT.—*Continued.*

BOROUGH OF COLNE.

Electrical Engineer.

WANTED, an Engineer to take control and management of Generating Station, Electric Plant and Equipment.

Present output about 1¼ million units per year.

Salary £350 per annum.

Must have had experience upon a modern E.H.T., three-phase and D.C., three-wire system.

Applications, stating age, experience, &c., with copies of not more than three testimonials, to be forwarded to the undersigned, on or before the 30th inst.

Canvassing of the members of the Town Council will disqualify.

A. VARLEY,
Town Clerk.

Town Hall, Colne,
December 10th, 1918. 3581

CHEMIST WANTED.

CHEMIST wanted at Generating Station in London district on large power plant. Experience in testing coal, water, oil, flue gases, &c. Must be acquainted with practical testing and economy work in connection with a large plant, and with the adjustment, minor repair and upkeep of flue gas and water recorders, softening plant, &c. Salary £200 to £250, inclusive of awards and bonuses to date.

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EXPERIENCED men are wanted by War Department to take charge of 20-KW. Oil-driven Camp Electric Lighting Plants near Plymouth. Salary £3 12s. 6d., plus 12½% war bonus, weekly.

Apply by letter, stating experience, to—

C.R.E. Plymouth,
R.E. Office,
Devonport. 3615

SWITCHBOARD ATTENDANTS.

WANTED, Two Switchboard Attendants experienced in 3-wire, D.C. lighting, D.C. traction and H.T. switchboards, also direct and inverted running of rotaries.

Good opportunites at present to suitable candidates for learning driving of Belliss engines and Westinghouse turbines.

Wages 10d. per hour, plus 6s., plus 12½ per cent.

Apply ENGINEER, Electricity Works, Chesterfield. 3616

ELECTRICAL FITTER.

ELECTRICAL Fitter required for repair and maintenance of motors, cookers, heaters, &c., and to carry out wiring work; similar experience essential.—Applications, giving particulars of training, experience, age and wages required, together with copies of recent testimonials, to be sent to S. T. ALLEN, Chief Engineer and General Manager, Corporation Electricity Works, Commercial Road, Wolverhampton. 3631

MAINS SUPERINTENDENT.

MAINS SUPERINTENDENT, for Municipal Electricity Undertaking in Scotland. Experience with high and low-tension networks. Wages £3 10s., plus 12½% war bonus.

Apply, stating age and experience, and with copies of testimonials, to—

3664, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

CHARGE ENGINEER.

CHARGE ENGINEER, for Municipal Electricity Undertaking in Scotland. Experience with H.T. and L.T. supplies. Wages £3 3s., plus 12½% war bonus.

Apply, stating age and experience, and with copies of testimonials, to

3665, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

TELEPHONE ELECTRICIAN.

WANTED, a Telephone Electrician for the maintenance of a large Tramways Telephone system. Must be able to test and do own repairs.

Apply, stating age, experience and salary required, to the—

GENERAL MANAGER,
Birmingham Corporation Tramways. 3663

SITUATIONS VACANT.—*Continued.*

RHONDDA URBAN DISTRICT COUNCIL.

Electricity Department.

CHIEF Clerk (temporarily) wanted at once, during absence of present clerk on war service. Knowledge of book-keeping and experience in electrical stores, meter readings, works costs and records essential. Three months' employment guaranteed.

Applications, stating age and experience and date to take up duties, with copies of testimonials, to be sent to the undersigned.

J. A. BOWMAN,
Engineer and Manager.

Electricity Works,
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APPLICATIONS are invited immediately for the position of Switchboard Attendant. Wages 62s. 3d. per week, including all bonuses to date. Preference will be given to a man with technical training and works practice.

Applications, stating age, training and experience, and when at liberty, to be received not later than THURSDAY morning, DECEMBER 26th, 1918.

J. B. PATTERSON,
Acting Borough Electrical & Tramways Engineer.

Electricity Works,
Lancaster. 3682

ASSISTANT INSTRUCTORS.

Ministry of Pensions Training Schemes for Disabled Men.

WANTED IMMEDIATELY, qualified Assistant Instructors for part time only in electrical engineering (laboratory practice), and also in installation, maintenance and repair work (practical).

Knowledge of A.C. and D.C. machines and of up-to-date installation practice is essential.

Apply, giving particulars of qualification and experience to Mr. F. H. TAYLOR, Central Polytechnic, Scarbrook Road, Croydon. 3688

SWITCHBOARD ATTENDANTS.

WANTED, two Switchboard Attendants, accustomed to three-phase E.H.T. and D.C. Switchboards; wages £3 8s. 6d. per week, including all bonuses.

Applications, stating experience, with recent testimonials, to be sent to the undersigned, not later than SATURDAY, the 28th DECEMBER, 1918.

J. E. STARKIE,
Electricity Works, Burnley. 3656

JOINTER.

JOINTER with thorough experience in jointing and maintenance of H.T. and E.H.T. lead covered and paper insulated cables, required immediately. Wages 50s. plus 20s. plus 12½%.

Apply, giving experience and testimonials to:—

CORPORATION ELECTRICITY DEPARTMENT,
Prince Rock,
Plymouth. 3600

SWITCHBOARD ATTENDANT.

SWITCHBOARD ATTENDANT wanted as Junior Shift Engineer, part generating and part bulk supply station. No night shift. Commencing wage 55s., 6½ shifts per week.

Apply with references, &c., BOROUGH ELECTRICAL ENGINEER, Electricity Works, Heywood, Lancashire. 3676

MAINS ASSISTANT.

ASSISTANT in Mains Department; knowledge of meters desirable; salary 70s. per week.

Apply, stating age and experience, to—

3615, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.

OVERHEAD LINESMEN.

LINESMEN, tramway overhead, required at once.—Apply, stating past experience, reference and wages required, to ENGINEER, Corporation Tramways, Vivash Road, Portsmouth. 3662

(Continued on next page.)

SITUATIONS VACANT.—*Continued.*

SHIFT ENGINEER.

SHIFT ENGINEER required immediately, certified undertaking. Alternating-current experience essential. Salary £208 per annum, inclusive of all awards of the Committee on Production to date. Appointment subject to one month's notice on either side.

Apply with full particulars, copies of testimonials, and date duties can be taken up, to R. N. TORPY, Borough Electrical Engineer, Tunbridge Wells. 3684

SECOND FITTER.

SECOND Fitter wanted, accustomed to turbine and engine overhaul and maintenance. Wage commence 10½d. per hour, plus 28s. 6d. awards.

Permanent job to suitable man.

Apply— CHIEF ENGINEER,
Electricity Works,
Cardiff Road,
Watford. 3687

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A FIRM manufacturing Electric Trucks require the services of a practical man as Works Superintendent. Must be good mechanical and electrical man; experience on electric trucks an advantage. Good organiser and capable of controlling men. The position is permanent and has good prospects for the right man.—Give full details, 3635, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

A FIRM of electrical contractors in Leeds require a Working Foreman, used to all kinds of motor repairs, A.C. and D.C., &c., Please state experience and wages required.—3642, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ARMATURE Winder, used to all kinds of D.C. repairs.—STEPHENS, SMITH, 40, Cuba Street, Millwall, London. E. 6439

ARMATURE Winder wanted. Experienced man, used to D.C. and A.C. windings. Not repetition work.—WESTMINSTER ENGINEERING Co., Willesden Junction, N.W. 10. 3565

ARMATURE Winders, used to repair shop, D.C. work.—Apply H. D. & S., 32, Newington Causeway, S.E. 1686

ARMATURE Winders wanted for South Wales accustomed to A.C. and D.C. repairs; permanent job; good wages to good men.—3618, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ARMATURE Winders wanted in London works. Permanent positions for really first-class men.—3652, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ARMATURE Winders wanted. Must be first-class men, accustomed to A.C. and D.C. repairs. Good wages.—Apply, LABOUR OFFICE, Ebbw Vale Works, Ebbw Vale, Mon. 3610

ASSISTANT Draughtsman required at once. One with experience in design of high and low tension oil break switchgear and mining switchgear.—Give particulars with experience and salary required, to NEW SWITCHGEAR CONSTRUCTION Co., LTD., Sutton, Surrey. 3653

ASSISTANT Electrical Engineer.—Wanted, thoroughly capable man as Assistant Electrical Engineer, for a large steel works on N.E. Coast. Applicants must have a thorough knowledge of A.C. and D.C. power requirements, be thoroughly conversant with high-tension work, including modern power station, sub-station and rolling mill equipments, and must also be capable of controlling men. Good prospects for a live six o'clock man.—Apply, stating age, salary required, and giving particulars of present employment and experience, and when at liberty, to 3630, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ASSISTANT Electrical Estimator, young, wanted in London district, on complete plant layouts, switchgear and transmission line schemes.—Apply, stating age and full particulars of experience, &c., to 3573, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ASSISTANT Engineer wanted for Diesel engine station; preference given to a good all-round man with Diesel, wiring and mains experience; permanent post.—Apply, stating wages expected, to H. G. WRIGHT, Electricity Works, Saltburn-on-Sea. 3589

ASSISTANT Manager and Salesman required by Electrical Contracting Firm, chiefly engaged in telephone installation work. A good opening for a pushing and capable man.—6475, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ASSISTANT Representative wanted for Scotland by well-known Electrical Cable Makers and Engineers. Salary and commission.—Apply, stating technical and other qualifications, and full particulars, to 3672, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ASSISTANT required for Electrical Showrooms in Yorkshire; one used to the sale of fittings, heating and cooking appliances.—State age, experience and salary required, to 3617, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ASSISTANT Works Manager wanted for works situated in the Midlands, manufacturing light electrical apparatus. To take charge of progress, shop orders, shop clerks, stock rooms, &c. Live man of good education, used to handling staff.—State particulars of education, age, experience and salary required, to 3519, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

CAPABLE and energetic young Electrical Engineer as Assistant wanted in technical office of London firm, manufacturing D.C. motor control gear. Must be conversant with motor control gear, and able to do correspondence.—Apply, stating age, experience and salary required, to the ELECTRICAL APPARATUS Co., LTD., Vauxhall Works, South Lambeth Road, London, S.W. 8. 6343

CHIEF Cost Clerk wanted with thorough knowledge Factory Accountancy for Electrical Switchgear Factory in Midlands. Experienced in costing small parts preferred; permanent position; good prospects for progressive and capable man.—State fully experience, qualifications and salary required, to Box 216, SELLS, LTD., 168, Fleet Street, E.C. 4. 6121

CHIEF Draughtsman required for transformer work by large engineering firm in the Midlands. Permanency for suitable man.—Apply, stating age, salary required and experience, to 3572, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

COLLIERY Electrician (working) wanted for Midland colliery. Experienced A.C. and D.C.—State age, wage and experience, to 6483, ELECTRICAL REVIEW, Hill, 4, Ludgate London.

CONTRACTORS for electric lighting and power wiring work in Manchester, want an Assistant Engineer and Traveller. One who is used to such work is essential. Applications will be treated confidentially. State experience, age, salary required and when free. Good salary and commission will be paid.—3643, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRAUGHTSMAN. High class progressive firm of telegraph, telephone, and high precision instrument manufacturers, requires services of first-class experienced Draughtsman; preferably man with electrical knowledge and workshop experience. Applicants to supply copies of recent references and testimonials, particulars of qualifications, and to state age and salary required. Only live energetic men who are abstainers and of good character, invited to apply.—Write Box 708, c/o Mitchell's Advertising Agency, 1, Snow Hill, E.C. 1. 3623

DRAUGHTSMAN required in central station; mechanical training desirable; wages £2 15s., plus bonus.—Apply in writing, giving particulars, ELECTRICAL ENGINEER, 50, Eden Grove, Holloway, N. 7. 3453

DRAUGHTSMAN required; must have experience small motor design; N. district. State age, salary and experience.—3434, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRAUGHTSMAN Section Leader, well versed in design of H.T. switchgear, wanted by North Country Firm.—3408, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRAUGHSTMAN wanted by Birmingham firm to take charge of section of drawing office, dealing with car, lighting, and starting equipment. Must have had first-rate experience of similar work, and thorough general engineering training. Permanent position for suitable man. Address, stating age, experience and salary required, to 6451, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRAUGHTSMAN wanted for North West London, experienced in design of electrical instruments and apparatus, used to manufacture of high grade precision instruments, accustomed to limits for quantity production, press tools and jigs for light repetition work. Technical training an advantage.—Applications in confidence, stating age, details of experience and salary required, to 6480, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRAUGHTSMEN, required for large electrical works in Midlands, preferably with practical and technical experience on instrument work, positions permanent and progressive.—Apply, stating age, full details of experience and salary required, to 3508, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

(Continued on next page.)

SITUATIONS VACANT.—*Continued.*

DRAUGHTSMEN required for transformer work by large engineering firm in the Midlands. Permanency to suitable men. —Apply, stating age, wages required and experience, to 3571, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRAUGHTSMEN.—Wanted, several good men for works in London district, with Switchgear experience.—Reply, giving full particulars, stating age and salary required, to 3561, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DYNAMO Testers, with previous experience, wanted for A.C. and D.C. machines for heavy output. Manchester district.—State age, experience and salary required, to 3490, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer for estimating office of electrical manufacturers in East London. Must be good correspondent and have thorough knowledge of D.C. plant, wiring, boosters, accumulators, &c. Salary £250 per annum.—State age, experience, to 3614. ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer (junior) required for electric manufacturer's H.T. test room, near Newcastle-on-Tyne. Must have good workshop experience.—Apply, stating age, qualifications and salary expected, to 3634, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Instrument Manufacturers require capable Works Superintendent or Production Foreman. Must be experienced in economical manufacture by means of press tools, jigs, capstans, &c. State experience, when free and salary expected. —3650, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN required to take charge of C.A.V. lighting on a fleet of 'buses. One with a knowledge of magnetos preferred. State wages, experience, &c.—TRAMWAYS COMPANY, Oxford. 3658

ELECTRICIAN wanted at once by engineering works, South London district. Full union rate of pay.—Reply by letter, stating age, experience, &c., to Box 721, c/o Mitchell's Advertising Agency, 1, Snow Hill, E.C. 1. 3674

ELECTRICIAN wanted for maintenance of motors (D.C.), lighting, and telephones in large clothing factory.—Apply by letter, stating wages and experience, to HART & LEVY, LTD., Leicester. 6381

ELECTRICIAN wanted, thorough knowledge of the repairing and overhauling of all types of magnetos, lighting sets, starters for automobile work, by firm in large industrial town in Scotland. One able to take entire charge preferred. Every encouragement given to suitable man. State age, experience and salary required. Only experienced men need apply.—6452, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN-Wireman, smart all-round hand for good class house work. State salary and experience.—72, Lancaster Road, W. 11. 6479

ENGINE Driver for small power station with Willans generator. —Apply BRITISH VEGETABLE OIL EXTRACTION CORPORATION, LTD., Angel Oil Mills, Edmonton, N. 3632

ENGINE Driver wanted. Used to reciprocating engines and turbines.—Apply, with full particulars and experience, age, and enclose copies of testimonials, to THE NORTHAMPTON ELECTRIC LIGHT & POWER CO., LTD., 25, Bridge Street, Northampton. 3537

ESTIMATING Engineer required for A.C. motor and switch work.—State full particulars of experience, age, salary, to 3608, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

EXPERIENCED Foreman or Forewoman required to take charge of flashing and mounting department, carbon filaments.—9728, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FITTERS and Turners wanted. Used to engine and general repair work.—Apply, with full particulars and experience, age, and enclose copies of testimonials, to THE NORTHAMPTON ELECTRIC LIGHT & POWER CO., LTD., 25, Bridge Street, Northampton. 3536

FOREMAN Armature Winder, Yorkshire.—Wanted, first-class man for A.C. work in progressive works. Must be able to design own formers and able to control both male and female labour. New work only and not repairs. Would be required to commence duties about middle of January.—Apply, stating experience and salary required, to 3613, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOREMAN Dynamo Assembler required; one accustomed to all types of dynamos for lighting and starting systems; first-class electrical and mechanical experience essential; permanent position and good prospects to suitable applicant with good organising abilities.—Apply, giving full details of experience and salary required, to JOSEPH LUCAS, LTD., Great King Street, Birmingham. 3654

SITUATIONS VACANT.—*Continued.*

FOREMAN wanted, first-class, for press shop, must be used to medium and small very accurate work; preferably with good experience in sub-presses; only first-class men need apply.—3648, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOREMAN wanted for girls' department, well up in formers, all classes of coil work and small motors.—State experience and wages required, 3619, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

IMPROVER wanted for D.C. station with turbines, batteries and B. and W. boilers.—State age, experience and salary required, to MANAGING ENGINEER, Electricity works, Banbury. 3679

JOINTER-Wireman required for high and low-tension cables. Able to do plumbing. One with experience of car-wiring preferred. Wages £3 15s. for 56-hour week, inclusive of all bonuses to date.—Applications, with experience, when at liberty, and enclosing copies of testimonials, to RHONDDA TRAMWAYS CO., LTD., Porth, Glam. 6375

LEADING Hand for manufacturers' meter test room; must have polyphase experience. — 6478, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

LIFT Repair and Maintenance.—Wanted, immediately in London capable Electrical Engineers accustomed to this work.—3554, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

MANAGER or Foreman required to organise and superintend a department for the manufacture of high-class storage batteries suitable for starting and lighting sets for motor cars; applicants must have a thorough knowledge of battery manufacture, and must be good disciplinarian.—3649, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

MANAGER Required for Dry Battery Factory; must be expert in the manufacture of all kinds of dry batteries, good organiser and capable of dealing with large output. — Apply, stating salary required and experience, 3576, ELECTRICAL REVIEW, 4, Ludgate Hill London.

PLUMBER-Jointer required by Electric Supply Undertaking in the Midlands. Good E.H.T. jointer. Permanency.—Apply, stating age, experience and wages, to 3460, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

REPRESENTATIVE wanted for North of Ireland by well-known firm of electrical cable makers and engineers. Salary and commission.—Apply, stating technical and other qualifications, and full particulars, to 3641, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

REQUIRED at once a man who thoroughly understands oil and gas engines and can carry out general repairs for same; and also who understands electrical installations.—Apply A. TYE, Sevenoaks. 6430

REQUIRED in drawing office (London) of company laying down plant at home and abroad, Man with General Knowledge of Electrical Machinery and experience of transmission line work and switchgear to develop layouts in connection with electrical equipment. Applicants to give particulars of experience and state age and salary required. — Write Z.A.225, care Deacons, Leadenhall Street, E.C. 3. 6473

REQUIRED, Telephone Faultsmen and Installers with intercom. experience. Good wages for good men. Permanency.—Apply between 9 and 10 any morning to I. T. C., LTD., 147/149, Great Portland Street, W. 1. 3397

REQUIRED, Traveller, with experience, for London district, for wholesale house of electrical accessories and fittings.—3415, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SECOND Fitter wanted, accustomed to turbine and engine overhaul and maintenance. Wage, commence, 10½d. per hour, plus 28s. 6d. award and 12½%. Permanent job to suitable man.—Apply CHIEF ENGINEER, Electricity Works, Cardiff Road, Watford. 3687

SMART Assistant Engineer wanted in country Supply Station. Should be accustomed to D.C. three-wire switchboard and gas and oil plant. Wages, 50s. per week, plus 12½ per cent.—Applications, with copies of three testimonials, to ENGINEER, Electricity Works, Ascot, Berks. 6488

STOREKEEPER wanted by Electrical Contractors in London. Preferably thoroughly conversant with wiring materials and accessories, also good organiser.—3639, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

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SITUATIONS VACANT.—*Continued.*

STOREKEEPER wanted for electrical contractor's stores.—3624, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

STRONG Youth (16-17) wanted as a learner in electrical and general engineering under the engineer to a hotel. Quarters, food and small salary given.—Apply, Knowle Hotel, Sidmouth. 6482

SUB-STATION Attendant wanted in London for 8-hour shift duties 7 days per week; rotary converter plant, total capacity between 1000 and 3000 KW.—6443, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SWITCHBOARD Attendant wanted for A.C. supply station, London district. Preference given to those with sound technical training and practice combined with steam experience. Wages £3 + 23s. 6d. + 12½% per week.—Apply, with full particulars, to RESIDENT ENGINEER, North Met. E. P. S. Co., Brimsdown, N. 6460

SWITCHBOARD Attendants (H.T., A.C. and D.C. Boards) and Stokers (B. & W. Boilers and Chain Grates), wanted at once. Steady work for competent men. Full district rate plus full current war bonus. — Apply MANAGER, nearest Employment Exchange, or write, giving full details of firms worked with, length of service, age, &c., to BRITISH THOMSON-HOUSTON CO., LTD., Rugby. 3685

TELEPHONE Engineer required, capable of designing complex circuits. State experience and salary required. — 3689, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

TECHNICAL Assistant wanted in electric lamp factory. Must have a thorough knowledge of all processes of manufacture of both drawn wire and carbon filament lamps, and be capable of speeding up output. Good opportunity for suitable man.—State age, experience and salary required, to 3651, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

TECHNICAL Engineer, with first-class experience in the design and construction of miniature motors, fans, A.C. and D.C., &c. —Write, stating age, experience and salary required, to Box 223, Sells, Ltd., 168, Fleet Street, E.C. 4. 3622

TELEPHONE Engineer required having good technical education and experience of telephone exchange equipments: good prospects and salary for qualified man.—State full particulars to 3577, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

TOOL Designer, Chief of Department. Must be thoroughly capable of designing and manufacturing, theoretically and practically, all tools, jigs and gauges in the telephone and electrical &c., industry. Permanent progressive appointment for suitable applicant; East London District.—State fullest details of experience, age and salary required, to Box 230, Sells, Ltd., 168, Fleet Street, E.C. 4. 6434

WANTED, a Designer for small Motors, &c., for electrical engineers' works near London.—Full particulars as to experience and salary required, to 3574, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED at once, Shift Engineer for 14,000-KW. power station. Experienced in E.H.T., A.C. and D.C. Must be sound mechanical engineer. Good permanent position for capable man. —3627, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Charge Engineer, with experience with turbines, water tube boilers, and E.H.T. 3-phase. Starting salary £3 10s. per week.—Apply, giving full particulars and enclosing copies of testimonials, to 3538, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED Electrical and Mechanical Engineer, energetic expert and reliable, qualified by practical, personal experience especially, to take charge of department installing electric light plant, gas and oil engines, turbines, pumps, dynamos, accumulators, electrical heating and cooking appliances for modern residences, hotels, convents, institutions and estates. To work hand in hand with sanitary, hydraulic and heating engineers in other departments in an old-established concern of contractors and merchants in Dublin, Ireland. To interview clients, travelling occasionally to inspect sites and residences, prepare estimates, obtain orders, and supervise work in progress. Apply in own handwriting, giving references, age, salary required, and full particulars. Replies will only be sent to apparently suitable candidates.—Box 950, care of Easons Advertising Agency, Dublin. 3580

WANTED, Electrical Fitter, first-class man; must have had experience on electric truck wiring. Permanent job for good man.—3636, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SITUATIONS VACANT.—*Continued.*

WANTED, experienced Driver, accustomed to steam turbines and vertical engines. Lancashire coast town. Hours 56 per week.—Apply, stating experience, age, &c., to 3454, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED for Government Contracts in Ireland, Assistant Manager with practical electrical experience in Installation work; must be a live business man.—Applications, stating age, experience, with copies of testimonials and salary required, to 6490, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, for Lancashire Electricity Undertaking, Arc Lamp Trimmer, used to Johnson & Phillips and G.E.C. magazine arc lamps. Wages 7½d. per hour, plus 28s. 6d., plus 12½%. Also Electrical Fitter, used to repair to similar lamps. District union rate, plus 28s. 6d., plus 12½%.—3633, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED for Power Company, Engineer-in-Charge, with E.H.T. three-phase experience and good mechanical training. Wages £3 10s. to £4 per week, inclusive of all bonuses.—Apply, giving all particulars, to 3590, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED for steel works and blast furnace plant in Monmouthshire, one Armature Winder accustomed to A.C. and D.C. repairs; also two Foremen Electricians to take 12 hours' shift, night shift and day shift, week about. Only men of experience need apply.—3428, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, for Yorkshire works, Electrical Designer for A.C. motors. This post will be a very progressive one for the right man.—Apply in the strictest confidence to 3621, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Gentleman used to catalogue compilation and minor advertising work, by one of the leading firms in the electrical trade.—Write stating age, qualifications and experience in similar work, together with commencing salary required, to 3493, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED immediately, several first-class Armature Winders; must be used to heavy-class work.—Apply BURDETTE AND CO., LTD., 7, Pocock Street, Blackfriars, S.E. 3433

WANTED, Improver in H.T.A.C.M.S., state age, wage, and experience. Experience in wiring necessary.—F. R. WINDSOR, Generating Station, Monmouth. 3488

WANTED, Outside Representative for electrical contractors in London. One with established connection preferred. Payment by salary or commission.—Apply, giving full details of experience, age and salary required, to 6448, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Scottish Representative to take charge of Glasgow office; must be well-acquainted with all classes of D.C. and A.C. motor control gear, and should have had similar experience before.—Apply, stating age, experience and remuneration required, to THE ELECTRICAL APPARATUS CO., LTD., Vauxhall Works, South Lambeth Road, London, S.W. 8. 6462

WANTED, several good Wiremen, factory work, 30 miles from London. — 3578, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Sub-station Attendant, Glasgow district; wages £15 per month.—3655, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WHOLESALE House require Traveller for London district. Previous experience preferred, but would entertain gentleman of good address with good knowledge of electrical accessories and fittings.—6485, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WIREMEN wanted. Permanency. Wages on basis of £3 6s. 3d. per 50-hour week, including all bonuses.—Reply, stating age and experience, to NORTHAMPTON ELECTRIC LIGHT & POWER CO., LTD., 25, Bridge Street, Northampton. 3606

WORKS Superintendent and Mains Engineer wanted for a 3,000-KW. Municipal Generating Station in Scotland, D.C. and A.C. generation and distribution. (1) Works Superintendent: Good mechanical and electrical experience. Capable carrying out all repairs and alterations, and of running economically the generating plant, consisting of turbines, engines, rotaries and water-tube boilers. (2) Mains Superintendent: Thorough training and experience in Mains work, capable of efficiently maintaining 3-wire D.C. high and low tension A.C. mains, and static transformer sub-stations.—Apply, giving age, married or single, salary expected, full particulars of training and experience, copies of recent testimonials, and date on which duties could be commenced, 3671, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

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SITUATIONS VACANT.—*Continued.*

YOUNG men required, with some electrical experience, to train as Assistants at electric vehicle battery depôt in London, and also as Assistant inspectors. Wages to commence £2 10s. per week. —Apply, stating age and experience, to 3416, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

12 Electricians wanted for permanent engagement in large chemical works; standard district wages.—Apply, LABOUR OFFICE, British Dyes Ltd., Turnbridge Works, Huddersfield. 3626

APPOINTMENT FILLED.

THE Newcastle-upon-Tyne Electric Supply Company thanks all applicants for the posts of Clerk and Draughtsman advertised on the 6th instant. The vacancies are now filled. 3646

SITUATIONS WANTED.

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.). Three Consecutive Insertions for the price of two, if ordered and prepaid with first insertion.
Box Number and ELECTRICAL REVIEW address count as seven words.

A BREWER'S Chief Electrical and Mechanical Engineer desires change.—6240, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

A CAPABLE Electrical Engineer (33), hard working, disengaged, 18 years' practical experience, conversant with gas, oil, supply plants, contracting, estimating, good references, successful works and station Engineer.—6492, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

A CONSTRUCTIONAL Supervising Electrical Engineer desires to get into communication with firms desiring his services now or in the near future. Ten years' experience of cable laying distribution work, ducts, solid, direct, &c., to 25,000 volts. Well up in power distribution for mills, steel works, &c., overhead transmission line erection, steel lattice poles, concrete, pine, &c., to 10,000 volts. Record work done South America, Portugal, France. Five years for English company. Conversant Spanish, Portuguese, French, Busque. Used handling large contracts, men and money. Will go anywhere on five years' agreement.—6367, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

A CONTINENTAL Representative, commercial engineer, more than 14 years' practical experience travelling Western Europe, extensive connections, excellent linguist, age 40, offers first-class services to important British manufacturers desiring representation in France, Belgium, Holland, Switzerland, or other countries. Salary and commission.—6453, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

A TELEPHONE Engineer (age 39), with 25 years' practical and technical experience of switchboards, inter-communications, alarms and relay work, all installation systems, inclusive automatics and dictographs, good circuit designer, and quick faultsman; seeks change as department foreman, or travelling representative, to advise, estimate or rectify installations, distance no object. Substantial references. State best terms.—6382, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ACCESSORIES, cable, conduit, motors. Advertiser (38) seeks progressive berth, 14 years' experience charge, sales, order, dispatch, practical and technical experience, nominal salary.—6332, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ADVERTISER, formerly managing engineer eminent London contractors, recently own business, 25 years' wide varied practical experience, seeks responsible position.—6409, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ADVERTISER (military officer) seeks to get into touch with concerns desiring to fill positions of superior responsibility. 15 years' experience covering factory planning and problems, railway signals, lighting and power, millwrighting, refrigeration, cranes, lifts and hoisting appliances, maintenance. Immediate interview.—6325, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ADVERTISER, thoroughly conversant charge, maintenance electrical plants, lighting, &c., works, hotels, estates.—6471, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ADVERTISER (25) requires responsible and progressive position. Good general electrical experience. Speciality wireless apparatus and plant. Capable organiser; accustomed to control of men and women.—6317, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SITUATIONS WANTED.—*Continued.*

AN Engineer, college diploma, practical training, 14 years' experience, electrical and mechanical, requires responsible post; contract work or maintenance preferred.—6301, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AN Engineer Lieutenant, R.N. (temporary), desires post as Chief Assistant in Supply undertaking. Responsible experience with modern plant of all types and sizes. Age 27. £250.—6361, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ARC Lamp Fitter; preference for corporations; thirteen years' experience on all types of flames and open arcs.—6234, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AS Works Chief Electrician, or Assistant to Contractor. Thorough experience. Erection, upkeep, supervision, interviewing, knowledge estimating. Complete installations, factory, town and country house. Good references.—6282, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ASSISTANT Engineer seeks situation abroad, Power Station (Diesel) and mains.—6429, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ASSISTANT Engineer (41), 24 years' experience large power and lighting installations, central stations, Diesel engines, telephone and lift installations, testing, workshop, office, commercial experience, control of men, initiative and business ability. 6410, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ASSISTANT Shift Engineer (24), officer (ex service), energetic, trustworthy, experienced in A.C. and D.C. machines, fitting and draughtsmanship; held responsible position in three-phase, E.H.T. to D.C. sub-station, desires early engagement in similar position; Lancashire preferred.—6416, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

BUYER of one of the largest houses in the country, desires re-engagement, at liberty shortly, engineering, building, and other classes of material.—6336, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

COMMERCIAL Engineer, at present with leading Scotch firm, wishes responsible position. Organising ability combined with extensive practical and commercial experience in the application of electricity to industrial problems. Technical training; good estimator, correspondent and interviewer. Interview Glasgow. —6258, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

CONSULTING Engineers open for further work.—6237, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

CONTINENTAL markets are our markets, if we manage our foreign departments properly. Secure the services of a first-rate commercial engineer, who speaks several languages fluently, and has excellent connection among power users, &c., abroad, acquired during more than 12 years of regular travel for British manufacturer. My experience and best services in exchange for adequate salary, commission and expenses.—6454, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRAUGHTSMAN, three years shops, 13 years drawing office, first-class experience in responsible capacity on D.C. and A.C. motors, desires change.—6467, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRIC Light, power, telephones, installations, or repairs. Used modern factory equipment, take charge or otherwise. —6294, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL and Mechanical Engineer (aged 43), having had over 20 years' experience in the manufacture, lay-out, erection and maintenance of power plants, accustomed to control large number of men, is now open for engagement.—6308, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL and Mechanical Engineer desires appointment; 12 years' experience in oil and gas-driven plant, power and lighting installations and maintenance; commercial experience; late Admiralty overseer; London district or Southern counties preferred.—6302, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL and Mechanical Engineer, experienced, 46, seeks situation, country; charge of plant, late of large country house plant, steam gas, oil, Diesel engines, dairy, laundry, saw mills, pumping plants, repairs, overhauling, alterations or improvements.—6474, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

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SITUATIONS WANTED.—*Continued.*

ELECTRICAL and Mechanical Engineer, fully trained (with special knowledge of Diesel plants, used to handling men and all classes of electrical and mechanical machinery), seeks responsible post.—6358, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer, age 23, nine years' shop and drawing office experience on A.C. and D.C. switchgear, desires position as Assistant in Sales or Estimating Office. Highest references; state salary.—6407, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer (age 26), technical and practical, requires position in maintenance at engineering works or factory, &c.—6484, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer, aged 30, workshop, technical and commercial training; salesman; experienced in the design and invention of instruments; knowledge of switchgear, machines and w/t. Three years' commissioned flying service, electrical branch. Desires correspondence with a view to appointment.—Address S.W., Grosvenor House, Grosvenor Road, Weymouth. 6370

ELECTRICAL Engineer, certificated, desires active position of trust. Wide practical experience in manufacturing and fitting, plant and installation work, controllers and lifts, extending over 28 years, possess a little sketching and drawing ability. Salary £195 per annum.—6459, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer desires responsible appointment in connection with electric lighting and power distribution, layout of installation, charge of power house, inspection of plant, &c., control of staff; economical working.—6261, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer, fully trained and experienced, seeks position in commercial dept. of electrical firm or electrical dept. of mechanical engineering firm. Willing to go abroad.—6252, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer, naval certificated, theory and practical, seeks appointment on demobilisation, good references, adaptable, understand all branches.—6436, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer, shortly be demobilised, 15 years' chief electrical engineer to large town. Previous consulting and contracting engineer. Good experience of power company's supply systems, Government departments.—6251, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer, university graduate, M.I.E.E., 23 years' wide and varied practical and commercial experience generation, distribution, industrial application and use electricity, desires responsible position with progressive manufacturer, contractor or consultant.—6233, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer, well up on all classes of electrical installations and constructional work, wide experience on E.H.T.O.H. transmission and hydro-electric installation abroad, seeks administrative position; good organiser.—6491, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer (28) having been through workshops, now engaged technical department leading firm, seeks position where this experience useful.—Particulars, 6351, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer (29), electrical engineering diploma, desires change. Sound technical education. Good mathematician; 12 years' practical experience, including workshop, testing department, drawing office, electrical machine design. Liberty at short notice.—6464, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer (30), four years' college, three years' apprenticeship, power house and test, drawing office, switchgear design. Prefer technical assistant to large undertaking or manager-designer of general electrical manufacturing shop.—6255, ELECTRICAL REVIEW 4, Ludgate Hill, London.

ELECTRICAL Engineer (31) desires engagement; 10 years' experience, including production, test and technical representative.—6246, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer (34) desires appointment; 15 years' wide practical and technical experience contracting, commercial, supervision transmission lines and cables, control of labour. £350 per annum.—6260, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SITUATIONS WANTED.—*Continued.*

ELECTRICAL Engineer (39), energetic, with 20 years' experience managing small power stations and doing installation work, wants appointment with prospects; North of England or London preferred; good saleman.—6477, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer (45), 20 years' practical experience, steam, petrol, oil and suction gas power plants, accumulators, mains, installations, telephones, estimating and interviewing, at present charge five contracts (country), all obtained on own initiative, desires appointment where thorough business ability and zeal is appreciated.—6321, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Mechanical Engineer (35) desires position abroad. Experienced steam, gas, Diesel, generating plants, A.C., D.C. Several years South America, nitrate production, control native labour, speaks Spanish, healthy and steady.—6442, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN desires post to take charge of installation on building or private plant; three years' experience with motor-generator and large circuit, and in wiring for heating, lighting, bells, &c.; can drive motor car; good references; London district preferred.—6476, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN, experienced mechanic, lighting, bells, telephones and motor installations A.C. or D.C.—"ELECTRICIAN," 325, Kilburn Lane, Kilburn, N.W. 6481

ELECTRICIAN, practical mechanic, disengaged, requires charge country house electrical plant, own repairs, good references, 6 years last job.—M. G., 2, Alexandra Road, Dagenham. 6371

ELECTRICIAN requires permanancy, used to erection and maintenance of factory and works plant.—6346, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ENGINE Driver, central station experience, high-speed engines and large turbines, want situation.—6487, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ENGINEER (Mechanical 1st B.O.T.) seeks responsible post; experience in D.C. lighting sets and in auxilary plant erection in power stations; also in national gas engines; age 27; married.—6463, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ENGINEER, millwright, thoroughly reliable, been in charge of large works, doing own erecting, own repairs, both electrical and mechanical. Excellent testimonials. Age 36.—POWELL, 70, Standen Road, Wandsworth, S.W. 18. 6383

ENGINEER, with 18 years' experience, requires position as Representative, Lancashire and Yorkshire district preferred, as advertiser is well known there in connection with Electrical Apparatus.—6276, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOREMAN Assembler, with long and varied experience in electrical industry, seeks situation with large firm of manufacturing electricians. Expert on Switchboard and Controller work. Sound references.—6280, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOREMAN Electrican. Power, lighting, telephone. Can estimate and interview.—6422, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

HOTEL Electrician (50) open for situation.—6489, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

INDIA.—Mechanical and Electrical Engineer, who speaks Hindustani fluently, requires responsible post. Holds first class B.O.T. Experience includes erecting and running plant, A.C. and D.C., D.O., refrigerating.—6236, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

MAN, young, seeks engagement as Works Foreman on electric wire manufacture; 18 years' experience in all branches.—6425, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

R.A.F. Officer (25), with good pre-war experience in electrical engineering, technical, drawing office, testing mains, and power station, desires to correspond with principals with a view to appointment. Interview can be arranged at any time.—6285, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

(Continued on next page.)

SITUATIONS WANTED.—*Continued.*

R.E. OFFICER (32); Modern Technical University, A.M.I.E.E., A.M.I.Mech.E. (by exam.), offers services. Four years large central stations, four years lay-out, installation and maintenance of lighting, power, heating, ventilating, elevator, vacuum cleaning and pumping plant, two years (France) E.H.T. generating and aerial distribution, pumping, wood and metal shops, petrol, oil and steam engines, and turbines, correspondence, agreements, specifications and organisation. Would consider active partnership and investment in small sound business.—6433, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

TO Managers of up-to-date Electric Supply Undertakings.—Capable Staff Engineer wants post. £300.—6283, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

TO Managing Directors.—Advertiser, a thorough Commercial Electrical Engineer (technical), with enormous City experience, dealing exclusively with War Office and Admiralty contracts, is open to engagement. Highest credentials, love of work and full of energy, gentlemanly in appearance and manners, fully conversant with business methods A to Z and knows precisely how to interview prospective clients. Army record, commissioned rank; discharged; limbs and brains left intact. Who will utilise to the best advantage?—6266, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, situation, Electrician's Assistant, youth.—M., c/o MACKEY, 15, Norland Gardens, W. 11. 6493

WIREMAN, discharged soldier, desires situation, with view of working abroad.—6441, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WIREMAN, used lighting, arcs, bells, screwed tubes, desires permanency in London factory, where could gain experience motor repairs, maintenance.—6347, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WORKS Foreman (or Manager), 20 years' practical experience in A.C. and D.C. motor control gear, switchboard, &c. Accustomed to up-to-date methods of production, tactful and capable organisér. Large Works experience.—6365, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WORKS Manager, with successful career, seeks similar position of trust with progressive company, manufacturing electrical accessories. Good organiser, sound practical, and commercial knowledge; experience in rate-fixing, estimating and control of male and female labour.—6292, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

£100 Cash down.—An electrical and mechanical engineer, aged 32, married, of 16 years' sound commercial and technical experience, well known, of unblemished character, and possessing the highest credentials from leading provincial and London borough electrical engineers, having been released from war service by the Ministry of Munitions, desires to return to his original profession, viz., the management of an electricity works (preferably a local authority); and as a reward he will pay the above sum to any individual who can secure him such a position as indicated. All communications will, of course, be treated strictly confidential.—6428, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

PARTNERSHIPS.

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.). Three Consecutive Insertions for the price of two, if ordered and prepaid with first insertion.
Box Number and ELECTRICAL REVIEW address count as seven words.

FIRM of Electrical Engineers in London about to extend their contracting branch, wish to negotiate with a gentleman who has an electrical business connection, on a commission or partnership basis. All office staff and expenses will be provided.—3404, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

GENTLEMAN (35), with small capital, wishes to correspond with another, with view to opening repair business for small electric motors, apparatus, &c., or an installation contracting business. London or Provinces. At present serving with H.M. Forces.—6281, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED for Provinces, practical man as partner in well-established manufacturing and factoring business of electrical and motor accessories. Good opportunity for right man. Capital required from £500 to £800.—6412, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AGENCIES.

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.).
Box Number and ELECTRICAL REVIEW address count as seven words.

A CABLE Agency.—Insulated wires and cables for electrical purposes. A London house of over quarter century's standing requires sole London and adjacent counties agency. Keen business house, having extensive connection and large storage accommodation. Negotiations with principals only.—6449, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ADVERTISER, 20 years' experience, wishes to represent Manufacturers of Electrical Accessories, Cables, Glassware, &c., for London and district.—Apply DAVIS, 11, Sun Street, E.C. 2. 3478

ADVERTISER, 20 years' experience, with live connection amongst best-class electrical houses, wishes to take up Agencies for London and district for French and English Electrical Fittings.—Apply DAVIS, 11, Sun Street, E.C. 2. 3479

AGENCIES wanted for all classes of Electrical Goods. First-class connections.—3486, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AGENCIES wanted.—Two gentlemen, with expert technical and commercial experience and influential connections with shipbuilders, engineers, are prepared to represent manufacturers of standing.—3681, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AGENCY for Tyne, Tees and Wear area, for post-war activities. An Electrical Engineer, of 20 years' standing, is prepared to act as Representative of single firm of manufacturers, or would work agencies for C.M.A. firm, generators, motors, transformers, &c., for reputed manufacturers of these articles.—6263, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AGENTS wanted in the following towns and districts for a well-known firm of Lift and Crane Makers: Aberdeen, Bristol, Plymouth, Cardiff, Hanley, Nottingham, Sheffield, Leeds, Harrogate, Newcastle, Hull, Belfast, Brighton, Portsmouth, Grimsby, Bournemouth, Manchester, Lowestoft, Folkestone, Weymouth, Torquay, Ilfracombe, Basingstoke, Winchester, Margate, Colchester, Ipswich, Bath, Hastings, Derby, Eastbourne, Tunbridge Wells, Reading, Southampton, Bradford, Scarborough; also in Belgium and France.—6274, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

BELGIAN firm wants to represent in Belgium and North of France, English manufacturers of everything electrical, Motors, Cables, Accessories. Free use of large stores and showrooms will be put at disposal of firms wishing to place goods in stock against bank deposit. Best references. First class firms only to apply.—6438, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

BELGIUM.—Electrical engineer (Belgian discharged soldier), good technical and practical training, 10 years' experience in electrical installations in Belgium, France, England, going back to Belgium shortly, would like to hear of British firms desirous to start business or agencies there.—A. COLLUMBIEN, 2, Woodlands Road, Cheetham Hill, Manchester. 6354

CABLE Agency, Yorkshire district. Wanted by C.M.A. member, Agent for Rubber Cables.—3601, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

COMMERCIAL and Practical Electrical Engineer, with valuable connection in Lancashire and Yorkshire, offices and stores in central position, Manchester, open to consider Agencies of high-grade Electrical Supplies for manufacturers.—6401, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

CONDUIT Agency.—Large Firm, with several Provincial Branches, desires to negotiate for an Agency for a good make of Conduit.—3661, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer (39), with varied experience, including telephones and telegraphs (manual and automatic), desires sole representation of first-class firm in France, Italy, or near East, immediately on discharge from army. Pre-war foreign experiences.—6432, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FIRM manufacturing Bells and Accumulators requires Agents (wholesale and retail), also commission representatives.—6494, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

GLASGOW Electrical Firm is desirous of representing manufacturers of Electrical Specialities, Labour-saving Tools, &c. Excellent showroom, storage accommodation and connection.—6200, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

(*Continued on next page.*)

AGENCIES.—*Continued.*

LOCAL Agents wanted in every town to represent the Cleveland Metal Co., Ltd., Bridge Works, Stockton-on-Tees, makers of White's Patent Controller Fingers, and Controller Fingers and Segments for all types of Controllers. Commission basis only.—6231, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

MANCHESTER Electrical Firm, with good show and store rooms, require Agencies for Motors, Dynamos, Switchgear and Conduit. First-class connections.—3485, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

NORTHUMBERLAND or Northern Counties Agencies.—Two R.E. Officers, expecting early discharge, are prepared to negotiate to represent as agents, electrical manufacturers of lighting, power, heating, or cooking plants. Extensive connection amongst supply authorities, power users and contractors, N.E. const.—6456, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

OLD-established electrical firm, with offices and stores in London, are open for agencies. Good connection among engineers, architects, builders and householders.—3553, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

REPRESENTATIVE for Lift and Hoist Engineers required in London, Liverpool, Birmingham, Bristol and other large towns. Electrical contractors suitable.—3557, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

TO Manufacturers of Conduits and Fittings, Wires and Cables, &c.—A concern with energy and a unique sales organisation is open to negotiatiate for Sole Agencies; efficiently covering Great Britain and the Continent, and in a specially good position to establish profitable connections in America.—Address E. R., c/o DIXON, 195, Oxford Street, W. 1. 6437

FOR SALE.

ELECTRICAL PLANT (220 Volts, D.C.) FOR SALE.

OWING to the Mill being converted to A.C. system, the following plant in good working condition is offered for sale, ready for delivery early in 1919. The Generators and Motors are mostly of Lancashire Dynamo Co.'s make:

GENERATING PLANT.—One 280-KW. and one 480 KW. direct coupled high speed Steam Sets.
Two 66-KW. Generators for belt drive.
One M.G. Set, converting 220 volts D.C. to 220 volts, single phase, A.C., 5 K.VA., 50 periods.

MAIN SWITCHBOARD.—Comprising one 1200 and three 600-amp. Circuit Breakers, 4 Ammeters, 3 Voltmeters, 4 Wattmeters, and 3 Field Regulators, together with one 3-way and one 2-way Panels with Switches and Fuses.

MOTORS.—Each complete with Starter, Switch and Fuses; also in many instances an Ammeter is provided:

Two 3/4	B.H.P., at	600	R.P.M.	Three 20	B.H.P. at	360	R.P.M.
One 2	"	1150	"	One 20	"	420	"
Two 3	"	1280	"	Five 20	"	600	"
One 3½	"	600	"	Three 27	"	360	"
One 10	"	600	"	Two 28	"	720	"
One 13	"	1100	"	One 65	"	420	"
One 15	"	1400	"	One 75	"	—	

Also Special Motors for driving Hydro-Extractors (Broadbents), five 12 B.H.P., three 8 B.H.P., and one 5 B.H.P., each complete with starter and switch.

The above plant may be seen by appointment. Application to be made to—

BURGESS, LEDWARD & CO., LTD.,
Watdley Mills,
Walkden, near Manchester. 3620

300-B.H.P. MOTOR.

MAKERS. Electric Construction Co., Ltd., 3-phase, 50 cycles, 400/550 volts, 415 R.P.M. In first class order, recently re-fitted and overhauled throughout at maker's works. Guaranteed in perfect order and running condition. Open protected type, with totally-enclosed slip-rings, brush lifting and short-circuiting device; two pedestal bearings and bedplate and two independent outboard bearings; no pulley; complete control panel with ammeter, automatic oil switch, totally enclosed oil starting switch. Available immediately. Can be seen running near Derby.

Price on site £600, or near offer.

DRAKE & GORHAM, LTD.,
47, Spring Gardens,
Manchester. 3667

FOR SALE.—*Continued.*

MACHINERY FOR SALE.

NO. 2 Direct-acting Steam-driven Air Compressor, 16" × 16" × 18", by the Ingersol Sargeant Drill Co.

Hori. Direct-acting Air Compressor, by the Ingersol Sargeant Drill Co., 12" × 12" × 12".

14" Hori. Air Compressor, by the Chicago Pneumatic Tool Company.

25-KW. Steam Generating Set, two crank Compound Engines direct coupled to 2-pole dynamo, 100 volts, 250 amps., 450 revs.

6·5-KW. Steam-driven Generating Set, by Robey & Co., direct coupled to 2-pole dynamo, 130 volts, 50 amps., 350 revs.

Compound-wound Bi-polar Dynamo, by Scott Mountain, 220 volts, 450 amps., 550 revs.

Hydraulic Cement Flag-making Plant, by H. Berry & Co., with intensifier.

Direct-acting Pump, 16" × 9" × 10", brass fitted with 5" suction, 4" delivery, by Guild & Garrison, U.S.A.

Compound Smith Vale Duplex Pump, 8" and 12" steam cyls., 12" water cyl., 10" stroke, brass fitted with 12" suction, 8" delivery.

CATALOGUE of Stock MACHINERY. 2-3000 LOTS.
Free on Application. Inspection invited.
THOS. W. WARD, LTD., ALBION WORKS,
Tel.: "Forward, Sheffield." SHEFFIELD.

R. H. LONGBOTHAM & CO., LTD., WAKEFIELD,
and at Milburn House, Newcastle-on-Tyne.
Tel.: { 44 Wakefield. / 867 Newcastle. } Telegrams: "Engineer, Wakefield."

FOR SALE.

ONE 500-KW. triple-expansion Set, engine by Browett and Lindley, H.P. cyl. 17¼", I.P. 25", L.P. 35" × 14" stroke. Single-phase Alternator, by British Westinghouse Co., 2100 volts, complete with exciter, &c.

One 225-KW. Generating Set, engine tandem comp. type, 300 H.P., with Corliss Valve Gear, &c., B.T.H. Generator, 500 volts, compound wound.

One Parsons Steam Turbo, 1500 KW., 2-phase, 2000 volts, 50 periods. Complete with condensing plant.

One Willans-Parsons Steam Turbo Set, 1200 KW., with Alternator, 1200 R.P.M., 200 lbs. to sq. in., 11,000 volts, three-phase, complete with exciter, also condensing plant, air, and circulating water pumps, &c.

Two Hopkinson Coal Cutters, electrically-driven, 450/500 volts, D.C., undercut 5' 6".

Two Diamond Coal Cutters, electrically-driven, 25 H.P., 500 volts, C.C., undercut 4' 6". 5277

COUNTY BOROUGH OF BOLTON.

Electricity Department.

PLANT FOR SALE.

THE ELECTRICITY COMMITTEE have for disposal Two 2000-H.P. Steam Engines, complete with Barometric Condensing Plant and 3-phase, 50-cycle, 6600-volt Alternators.

Full particulars and Specification of Plant may be obtained on application to the BOROUGH ELECTRICAL ENGINEER, Back-o'th' Bank Generating Station, Bolton.

Tenders endorsed "Sale of Plant," addressed to the Chairman of the Electricity Committee, Town Hall, Bolton, must be delivered to the undersigned not later than 12 noon, JANUARY, 15th, 1919.

The Committee do not bind themselves to accept the highest or any Tender.

SAMUEL PARKER,
Town Clerk.

Town Hall, Bolton,
December 16th, 1918. 3666

MACHINERY, &c., FOR SALE.

FOR Sale, Generator or Motor, 110-volt, 164 amps. D.C., 950 R.P.M., three-bearing machine.

1, 5, 10, 15, 18, 25 and 30 H.P., D.C., 220 v. and 440 v.

1, 2, 3, 5, 10, 15, 25, 30, 35-H.P., A.C., 2 and 3-phase, 220 and 440 v., Starting and Switchgear.

Four miles 1/18, five miles 3/22, 3/20, 7/20, 7/18, 7/14, 7/16, 19/16, 37/16, Association and Non-Association, 600 meg.

D.P. and T.P. Switch Fuses, 15 to 200 amp. D.P. Fuse Boards, 10/20 amp. per way. Iron-clad, Home Office Pattern, 4 to 12 way.

Immediate delivery and all guaranteed. In stock for inspection. Your enquiries please.

"ROBUST MACHINERY,"
62, Bradford Street, Walsall.
3563

(*Continued on next page.*)

FOR SALE.—*Continued.*

MACHINERY FOR SALE.

D.C. MOTORS.

H.P.	Volts.	R.P.M.	Windings.	Makers.	Type.
30	400/440	850	Shunt intple.	Royce Bros.	Encl's'd, v'ntilat'd.
27	460/480	950	" "	Brush Elec.	" "
20	440/460	750	" "	Bruce Peebles	" "
20	440/460	1250	" "	E.C.C.	Tot. en., pipe vent.
15	230	800	" "	Royce Bros.	Encl's'd, v'ntilat'd.
13	400/420	1000	Shunt wo'nd.	Mather&Platt.	Totally enclosed.
12	200/220	950	" "	Cutting Bros.	Encl's'd, v'ntilat'd.
10	420	1000	" "	Electromotors.	" "
10	400/440	750	Shunt intple.	"	Totally enclosed.
9½	400/460	750	" "	E.C.C.	" "
8	230	480	" "	Royce Bros.	Encl's'd, v'ntilat'd.
8	440	950	Shunt wo'nd.	Gen. Elec. Co.	Tot. en., reversing.
7½	440	880	" "	Siemens Bros.	Encl's'd, v'ntilat'd.
7½	230	880	" "	" "	Totally enclosed.
5	230	880	" "	" "	Encl's'd, v'ntilat'd.
5	440/460	1200	" "	Cutting Bros.	" "
4	400	1150/1835 variable.	" "	Gen. Elec. Co.	" "

A.C. MOTORS.

H.P.	Volts.	R.P.M.	Periods.	Phase.	Makers.	Type.
30	400	750	50	Three.	Clayton Motors.	Encl's'd v'ntilat'd.
12	420	960	50	"	Gen. Elec. Co.	" "
10	440	950	50	"	Brook & Co.	Tot. en., pipe vent.
5	420	1450	50	"	Wright & Wood.	Encl's'd v'ntilat'd.
3	420	1450	50	"	" "	" "

GENERATORS.

17 KW., 230 volts, 1200 R.P.M., shunt wound, Holmes & Co., makers, enclosed, ventilated type.
300 watt, 160 volts, 1250 R.P.M., shunt wound.

YARNALL & CO.,
Cornwall Street Ironworks,
Openshaw, Manchester. 3259

GENERATING SETS FOR SALE.

TWO 500-KW. Belliss & Morcom-Bruce Peebles, 500 volts, D.C.
One 150-KW. Belliss & Morcom-Bruce Peebles, 500 volts, D.C.
One 500-KW. Browett, Lindley-Bruce Peebles, 500 volts, D.C.
One 150-KW. Belliss & Morcom-Silvertown, 220 volts, D.C.
Two 178-KW. Scott & Mountain's, 220 volts, D.C.

For particulars, apply,
ROBERT WALKER,
2, Oswald Street,
Glasgow. 3303

FOR IMMEDIATE SALE.

THREE A.C. Generating Sets, comprising compound double-acting high-speed Engines ("Sentinel"), 220 B.H.P. each, coupled direct to 150-KW. Generators (Westinghouse), 440 volts, 25 periods, three-phase.

Two D.C. Generating Sets; compound, double-acting high-speed Engines ("Sentinel"), 45 B.H.P., coupled direct to 30-KW. Generators (Westinghouse), volts 250.

Four Durr Water-tube Boilers, 1614 sq. ft. H.S. each; working Press 120 lbs. per sq. in.

One Main Switchboard and Accessories, &c.

All in good order.

For further particulars, apply to WM. D. HAMILTON, Consulting Engineer, 59, Bath Street, Glasgow. 3239

ELECTRICAL PLANT FOR SALE.

ONE 300-KW., 220/250-volt Generating Set, comprising "Howden" enclosed compound engine, coupled to compound interpole Generator.

One 500-KW., 220/250-volt Generating Set, comprising "Belliss" enclosed compound engine coupled to compound-wound Generator, and complete with condensing plant.

One 450-KW., 500-volt Set, as above, with or without condensing plant.

THE PHŒNIX ELECTRICAL CO.,
32—36, Broomielaw,
Glasgow. 2429

OERLIKON TURBO-GENERATOR.

FOR SALE, one 1050-KW. L.P. Oerlikon Turbo-Generator, 1500 R.P.M., 6000-volt, 3-phase, 50 periods. Turbine designed for use with exhaust steam at atmospheric pressure. Generator, asynchronous type. Contraflo Surface Condenser, 3350 sq. ft., by Richardsons, Westgarth & Co., with Edwards air pump and circulating pump. The plant is in first-class running order, and can be seen at work at any time by appointment.

For full particulars apply to the CENTRAL ELECTRIC SUPPLY CO., LTD., Grove Road, St. John's Wood, N.W. 6348

FOR SALE.—*Continued.*

GAS ELECTRIC PLANT.

FOR Sale, the following Gas Electric Plant, which is being superseded for a more extensive supply :—

One practically new Mond Gas Producer, 1200 B.H.P. continuously, for supplying Mond gas for driving gas engines, and supplying gas for furnaces, complete with Coal Handling Plant. Available now.

Three 105-KW. Hindley 5-cylinder vertical Gas Engines, direct coupled to 500-volt D.C. Generator. Available now.

Two 180-KW. do. do., in process of manufacture.

One 35-KW. do. do., just delivered.

Two 205-B.H.P., 500-volt Motors, 290 revs., suitable for direct coupling to Compressors.

One compound-wound Generator, 310 amps., 240 volts, 540 R.P.M.

One compound-wound Generator, 128 amps., 250 volts, 900 R.P.M.

For further information apply to MESSRS. TELFORD, GRIER AND MACKAY, LTD., 16, Carrick Street, Glasgow. 3190

FOR SALE.

12-VOLT DYNAMO, 750 amps., two Commutators, 1150 revs. Almost new. Makers: Canning & Co.

140-volt Dynamo, 50 amps., 1030 revs. Makers: Greenwood & Batley.

Transformer, 3-phase, 500 to 220 volts, 50 periods; output, 15 K.V.A. continuously. Secondary pressure can be changed easily to 110 volts. Makers: Ferranti.

Alternating Motor Starter, large size. Makers: Erskine, Heap & Co.

55 yards double-wire armoured, 19/16 three-core Cable, Association; 2500 megohm grade.

Particulars from—

JAMES NEILL, LTD.,
1, College Place North,
Belfast. 3513

FOR SALE.

ONE Armature, new, never used, suitable for 1,500-KW. generator at 220 volts, D.C., by Clarke, Chapman & Co.
One complete set of Field Coils for 9-KW. generator, compound wound, 100 volts, D.C., by Clarke, Chapman & Co.
Four 18-hour and eight 12-hour A.C. Union Electric Excello Arc Lamps.
One D.C. Excello Arc Lamp. All in good condition.

Offers to Z. T. 200, c/o S. Deacon & Co.,
7, Leadenhall Street, E.C. 3. 6386

GAS ENGINE FOR SALE.

A CROSSLEY "N E" (12 maximum B.H.P.) electric lighting type Gas Engine, fitted with single heavy flywheel and supported by outside bearing, complete with tank and all accessories. Just been removed from a mansion; guaranteed in first class and perfect condition throughout. Price, f.o.r. Bristol, £97 10s.

COOK,
5, Elton Road,
Bishopston, Bristol.
'Phone 757. Telegrams: "Exhaust," Bristol. 3569

FOR SALE.

250-KW. Belliss-E.C.C. Set, comprising Belliss high-speed, 3-crank, compound engine, direct-coupled to E.C.C. generator, 440/460 volts, D.C., 560 amps., 380 R.P.M., with Körting ejector compound, also spare armature. Can be seen running by appointment.—BURY ELECTRICAL PLANT CO., LTD., Phœnix Street, Bury. 2746

SPECIAL MOTOR AND GEAR.

40-H.P., D.C., 440/500 V., back gear, silent pinion; complete with starting panel, D.C. starter, switch fuses and meter.
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"ROBUST MACHINERY,"
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(*Continued on next page.*)

FOR SALE.—*Continued.*

MACHINERY FOR SALE.

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1000-KW. Turbo-Generator, A.E.G., 500 volts, 50-period, 3-phase, complete with two switch panels, surface condenser, electrically-driven air and circulating pumps, together with the piping and a quantity of new spare parts. The whole practically equal to new and ready for immediate despatch at Liverpool.

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One	12 H.P.,	200 V., D.C.		Two	10 H.P.,	110 V., D.C.	
,,	10 ,,	200 ,,		One	11 ,,	110 ,,	
,,	3 ,,	240 ,,		,,	2 ,,	200 V., 50 per., A.C	
Two	5 ,,	480 ,,		,,	3 ,,	200 ,,	,,
One	3 ,,	480 ,,		,,	3 ,,	400 ,,	,,
,,	8 ,,	440 ,,		,,	8 ,,	400 ,,	,,
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FOR SALE.—*Continued.*

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(*Continued on next page.*)

FOR SALE.—*Continued.*

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FOR SALE.—*Continued.*

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GENERATORS, 50 v., 80 a.; 60 v., 50 a.; 135 v., 60a.; 4 v., 2000 a.; 110 v., 25 a.; 110 v., 200 a.; 110 v., 400 a.; 135 v., 200 a.; 75 v., 200 a.; 135 v., 30 a.; 250 v., 90 a.; 25 v., 25 a.; 66 v., 35 a.; 110 v., 70 a.; 200 v., 45 a.; 230 v., 30 a.; 110 v., 37 a.; 50 v., 12 a.; 25 v., 6 a.; 100 v., 60 a.; 110 v., 110 a.; 220 v., 100 a.; 70 v., 25 a.; 135 v., 40 a.; 60 v., 120 a.; 60 v., 12 a.; 6 v., 50 a.; 6 v., 100 a.; 75 v., 130 a.; 220 v., 15 a.—6469, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

Continued on next page.

FOR SALE.—*Continued.*

MOTOR for Sale, 6-H.P., slip-ring, 3-phase, 415 volts, 50 per., 1400 revs., pulley 6" dia., 4" face; complete with starting gear. Perfect condition. Price £45. Can be seen running on load.—F. YOUNG, 43, Roebuck Road, Rochester. 6440

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190-H.P., six-pole D.C. Motor, by Ernest Scott & Mountain, 500 volts, arranged for rope drive.—HARRY H. GARDAM AND CO., LTD., Staines. 2827

250-KW. Steam Set, comprising Belliss engine, direct coupled to Silvertown dynamo, 500 volts, D.C. Available for prompt delivery.—HARRY H. GARDAM & CO., LTD., Staines. 3435

300-AMP. Welding Dynamo, bi-polar, by Holmes, Newcastle. In new condition.—DRUMMOND & CO., Middlesbrough. 6444

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(*Continued on next page.*)

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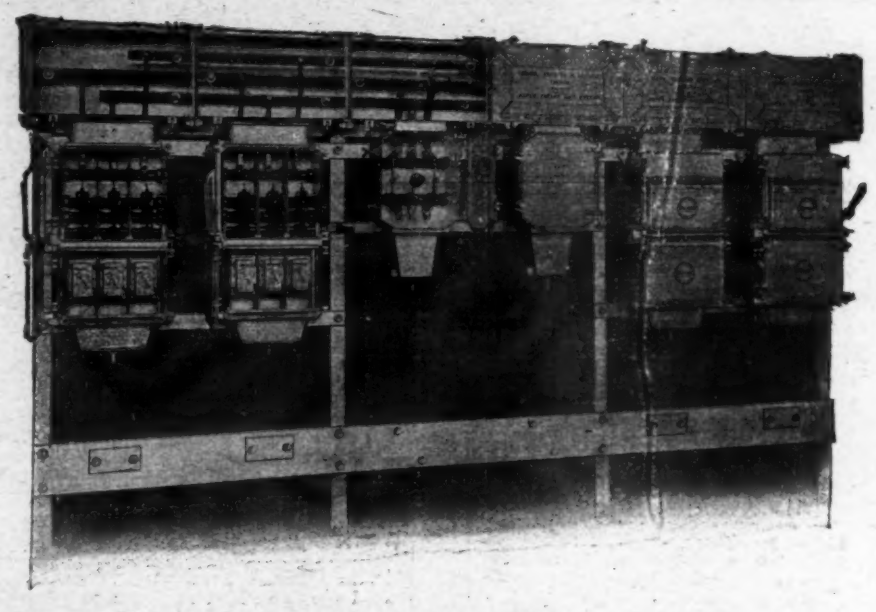

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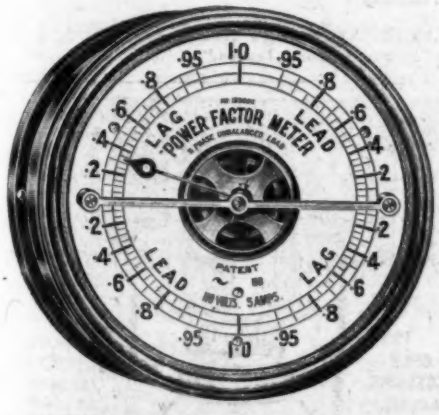

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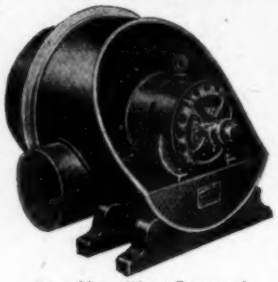

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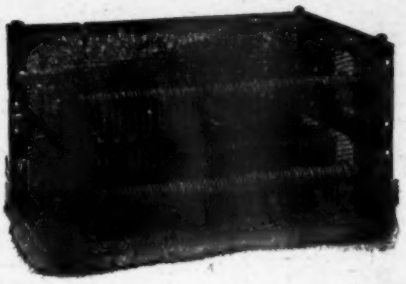

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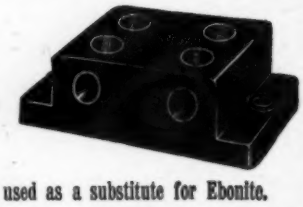

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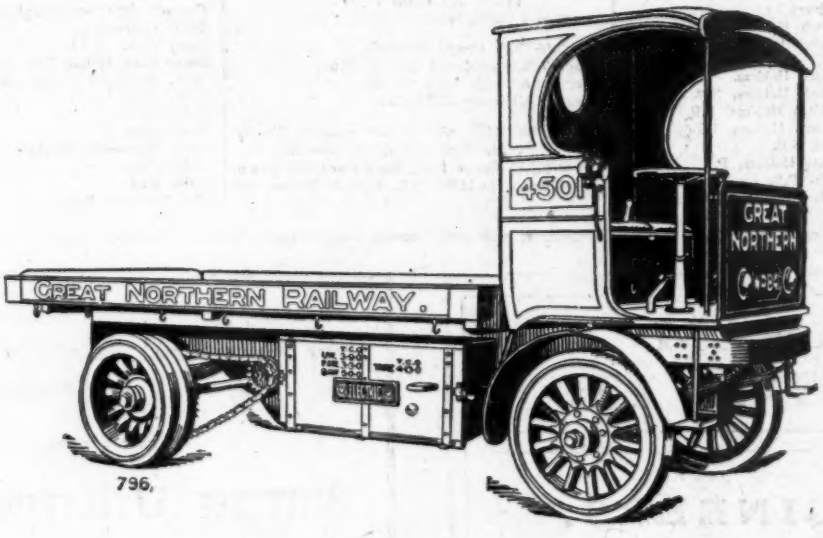

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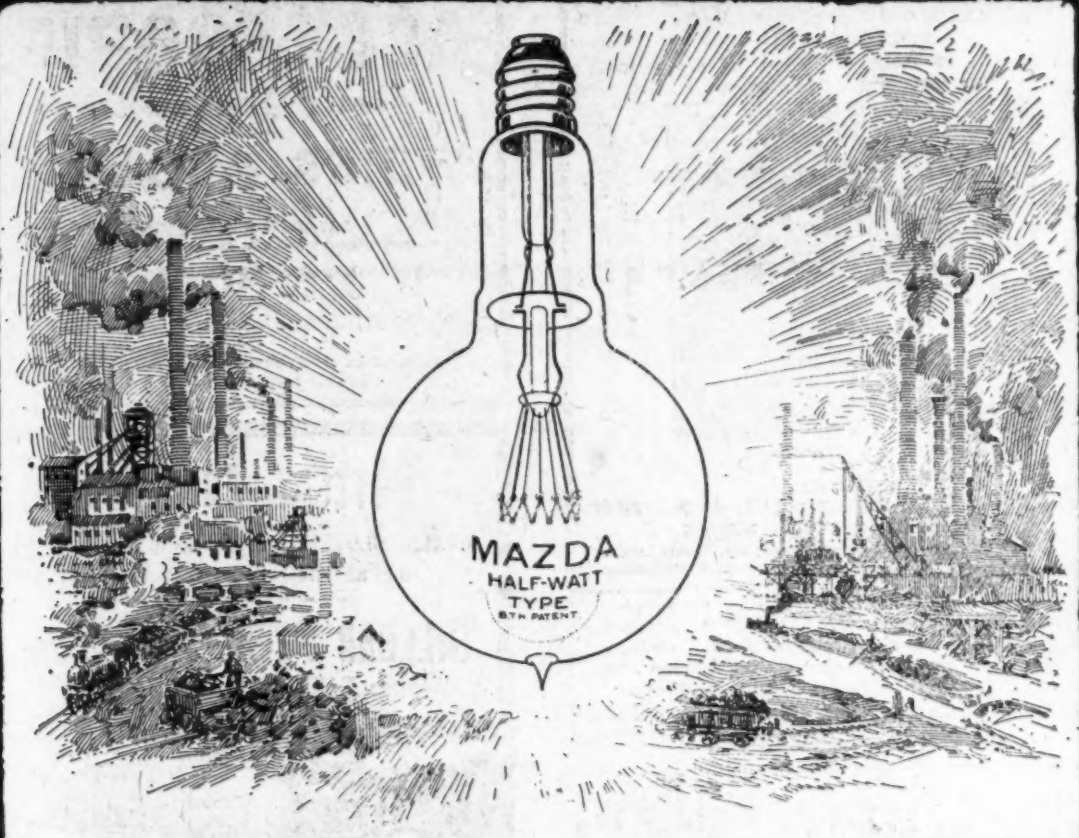

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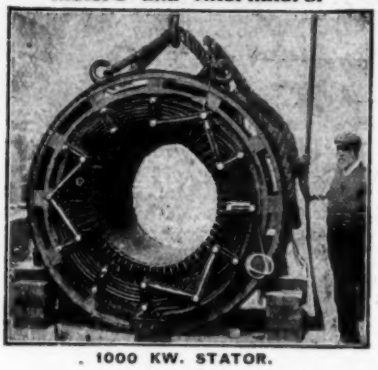

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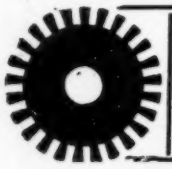

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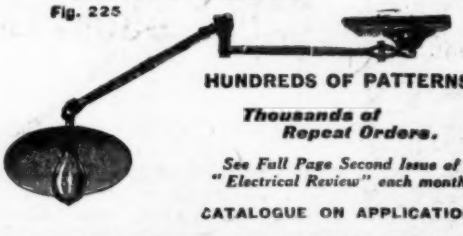

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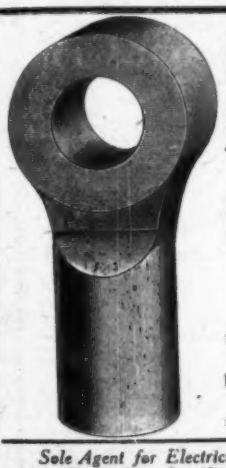

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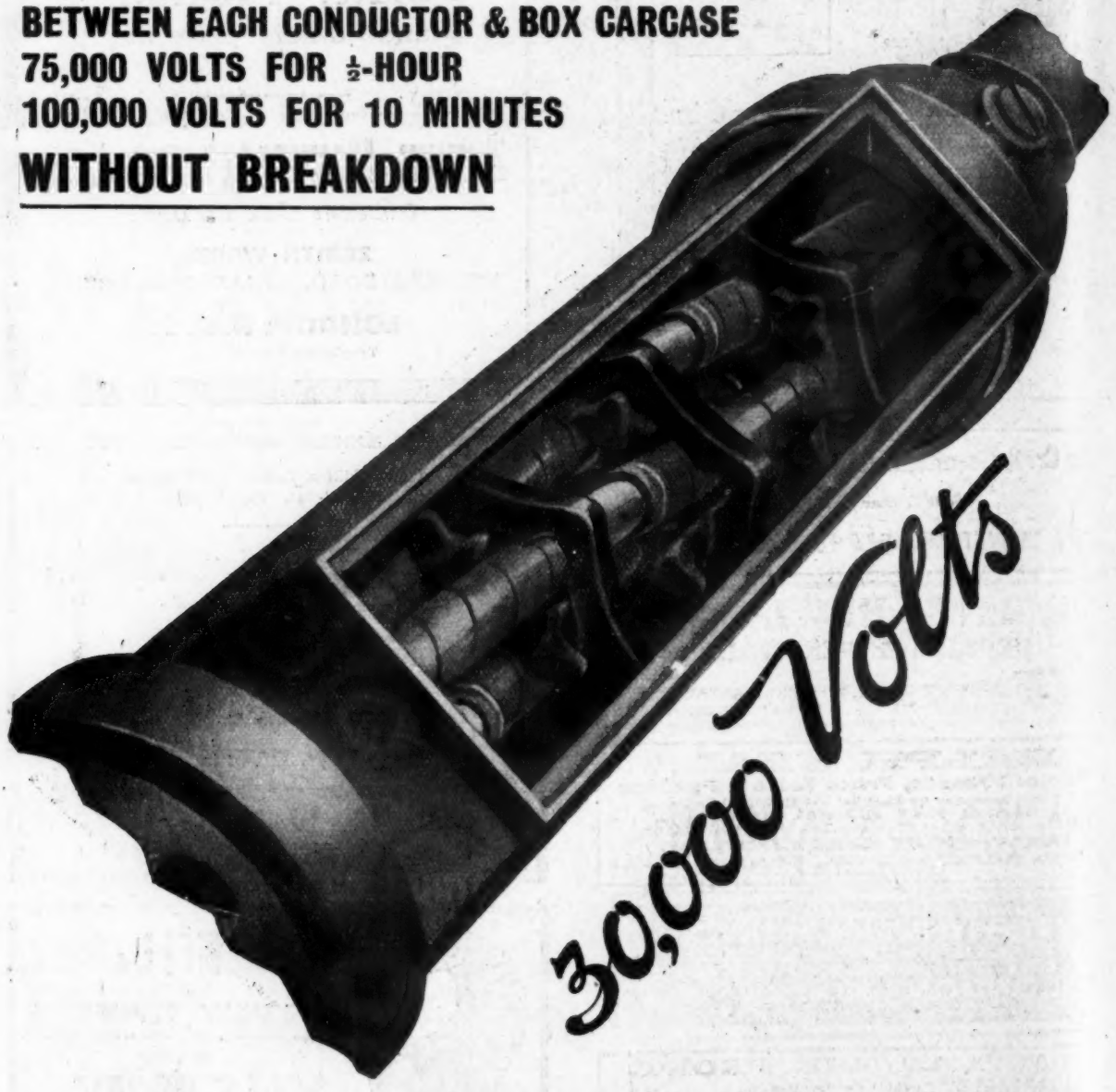

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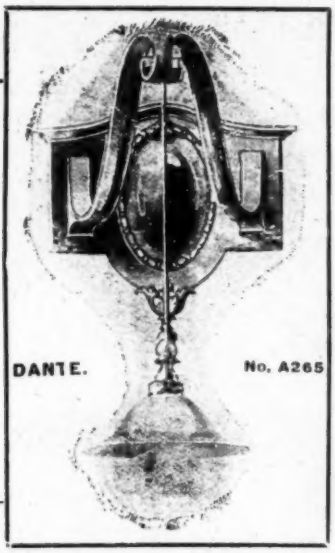

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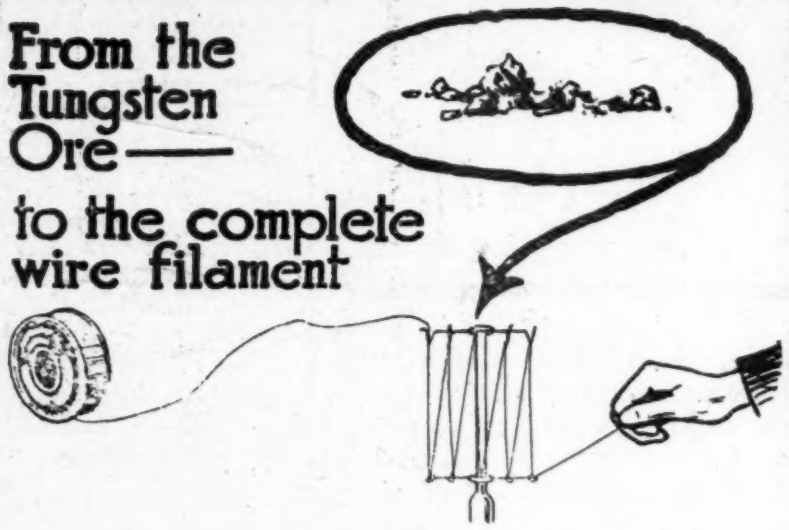

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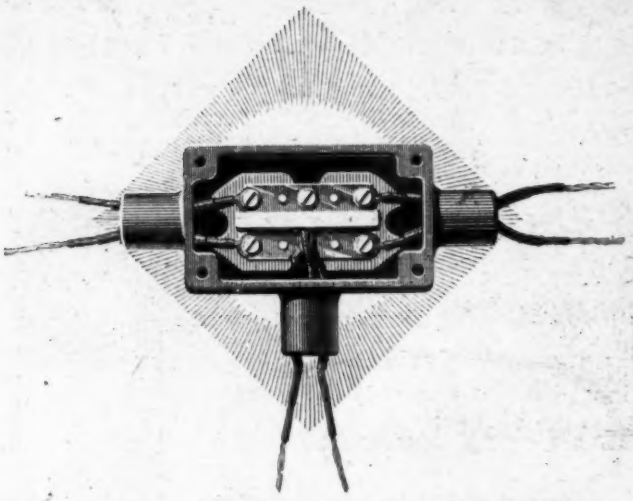

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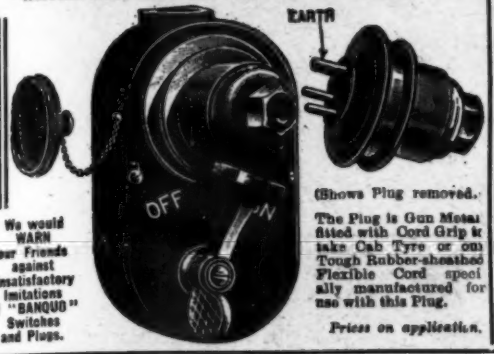

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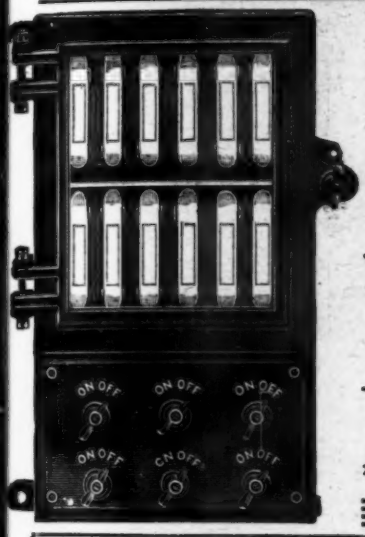

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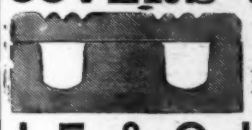

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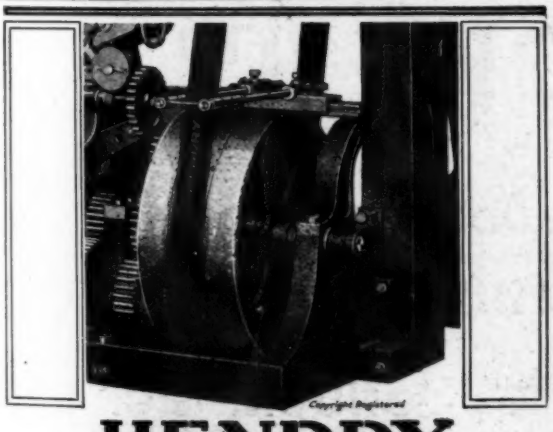

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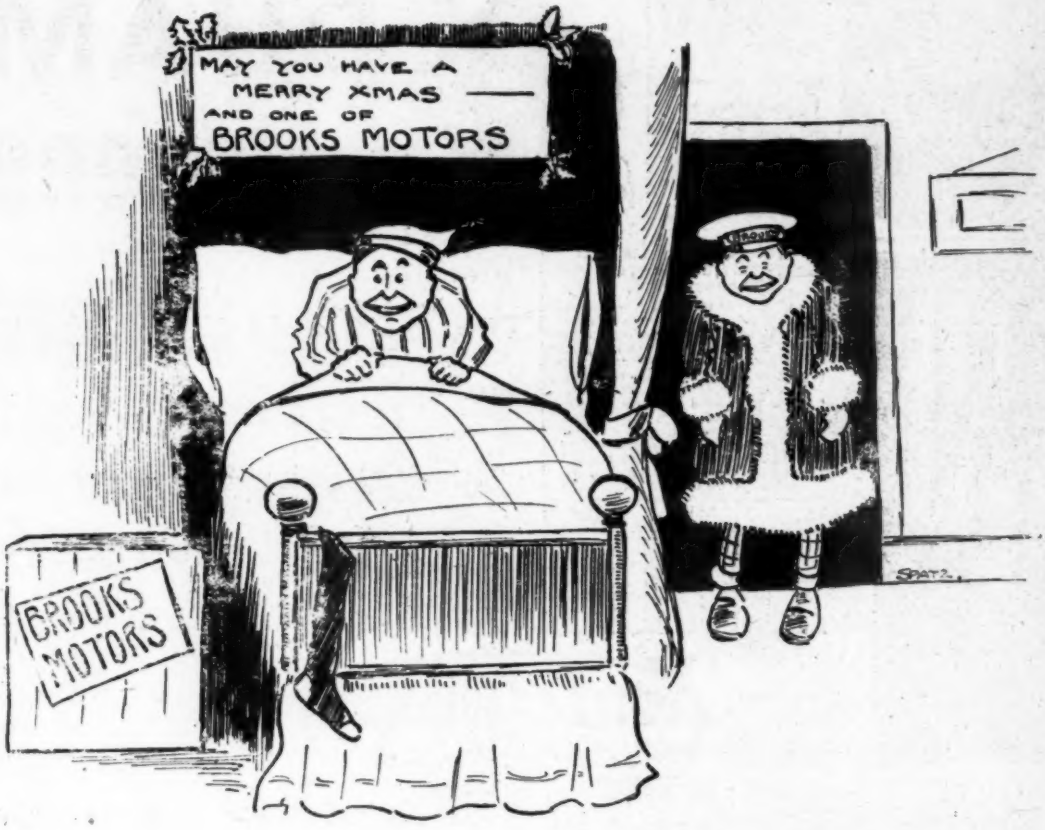

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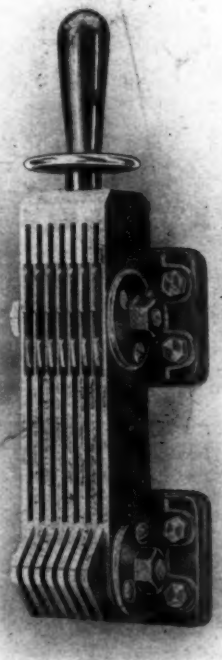

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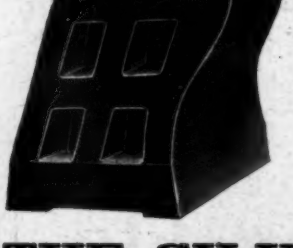

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Queensland.—The Government, which had definitely refused to grant any further permits for private companies to install electricity supply undertakings, has now stated its willingness to grant permits to local authorities, or combinations of local authorities, for the purpose.—*Tenders.*

Melbourne.—The City Council has schemes in hand, estimated to cost £225,000, for the improvement of the electricity undertaking during the next three years. The E.S. Committee proposes to purchase energy from the Railway Department, and to erect a new sub-station, at a cost of £100,000.

Victoria.—The Government is considering the utilisation of the Upper Goulbourn, Acheron Valley, Snob's Creek, and other rivers, for the generation of electricity.

Bideford.—Proposed E.L.—The local Chamber of Commerce has passed a resolution in favour of an E.L. scheme for the district, and has decided to further the proposal.

Broadstairs.—Street Lighting.—The U.D.C. has decided to arrange with the Thanet Electric Tramway and Lighting Co. for the provision of 11 additional electric street lamps on the Parade.

Canterbury.—Street Lighting.—The T.C. has decided that from the quarter ending December 31st the charge for street lighting by electricity shall be the present charge for capital and interest, plus consumption at power prices and the cost of renewals. Messrs. Pritchett & Gold have been granted an increase of 5 per cent. on the contract price for the maintenance of the accumulators for each £1 by which the price of lead exceeds £18.

Chelmsford.—Price Increase.—The Electric Supply Corporation has applied to the B. of T. for powers to increase the charge for electricity from 6½d. per unit to 8½d.; the T.C. has considered the matter, and considers that 1d. per unit increase would be sufficient, and that the minimum charge should be abolished altogether.

Chester.—Extension of Supply.—The E.L. Committee has recommended the T.C. to apply for B. of T. consent to supply electricity by overhead mains to the premises of Messrs. Webb and Sons, which are in the area of the Hawarden U.D.C., and an additional supply to Messrs. J. Crichton & Co. The capital cost, estimated at £4,572, is to be provided by the firms in question, and repaid by the Corporation before the end of seven years.

A Special Committee has been appointed to report on all questions relating to the development of the city.

Chester-le-Street.—Electricity Supply and the Fuel Controller.—The action of the Electric Supply Co., in refusing to comply with a request by the U.D.C. Fuel Control Committee to have check meters installed at houses where electricity is supplied unmetered, has been upheld by the higher authorities.

Continental.—Finland.—Water Power.—The Government has decided to purchase the waterfalls in Northern Finland for 10,000,000 marks, and proposes to lease them to different companies, in which the State will hold a certain number of shares.—*The Times.*

Chertsey.—Correction.—The note headed "Chertsey" in our last issue should have been headed "Weybridge."

Dover.—E.L. Charges.—The B. of T. has refused sanction for the T.C. to increase the maximum charge for electricity.

Edinburgh.—Price Increase.—The E.L. Committee has recommended the Corporation to increase the price of electricity for lighting purposes from 3½d. to 4d. per unit, and by ½d. per unit for power.

Leiston.—Proposed E.L.—The Lighting Committee has recommended the Council to consider the advisability of installing an E.L. scheme for the town.

Lincoln.—L.G.B. Inquiry.—On December 10th the L.G.B. inspector (Mr. T. C. Ekin) held an inquiry into the application of the Corporation to borrow £250,000 for electricity purposes. The Council is seeking to acquire Messrs. Clayton & Shuttleworth's generating station, for the purpose of supplying electricity to the general public and large works in the district. The Town Clerk stated that there would be a great demand for electricity from the engineering firms in the district, and one firm alone estimated that 2,000 houses would be required to house the additional workmen who would be employed by them. Sir John Snell stated that unless there was a big industrial development in the area between the generating stations at Rotherham and Sheffield and on the River Trent it would not be commercially possible to transmit energy a distance of 30 miles. Lincoln being 30 miles from any source of supply, the only alternative was for the city to develop its own power supply. The present station of the Corporation was inadequate, and the proper course was for the Corporation to put down a generating station capable of supplying all present and future demands for power. Negotiations for the acquisition of Messrs. Clayton & Shuttleworth's power station had been entered into, and agreements for the supply of power to that firm and to Messrs. Ruston & Hornsby had been entered into for 11 years.

London.—Fulham.—The L.C.C. Finance Committee recommends the sanction of the Council to the borrowing of £7,230 by the B.C. for electricity purposes.

Hackney.—Street Lighting.—The Electricity Committee reports that, in order to comply with the lighting restrictions, the 496 arc lamps used for street lighting in the borough were replaced by 32-c.p. carbon-filament lamps. The Committee now recommends that 401 of the arc lamps be not reinstated, but that 600-c.p. half-watt lamps be used in their place. The cost is estimated at £3,026, less the amount obtained by the sale of the obsolete lamps.

Newark.—E.L. Bill.—The local Tradesmen's Association has asked the T.C. to oppose the Gas Co.'s Bill for powers to supply electricity, and has recommended the Council to obtain powers to supply electricity itself.

Shanklin.—Street Lighting.—The U.D.C. is considering an offer from the Isle of Wight E.L. & P. Co. to light half the public lamps in the town at £415 per annum.

Swindon.—Extensions.—The T.C. has approved of an agreement for the supply of electricity to the Government ammonium-nitrate factory at Stretton.

Warrington.—Loan Sanction.—The T.C. has received sanction to loans of £10,330 for boiler plant and £1,670 for a mechanical stoker, &c., at the electricity works.

Wigan.—In moving the confirmation of the minutes of the Electricity Committee, Alderman Grimshaw stated that he considered that Wigan would be called upon to supply the surrounding district with electricity, in connection with the proposed centralisation of supply. Wigan was surrounded by a thickly-populated district, and the demand could not be less than 50,000,000 units per annum, and if the works of the Metallurgical Corporation assumed the proportions which were expected, the demand would be about 100,000,000 units per annum.

TRAMWAY AND RAILWAY NOTES.

Australia.—Victoria.—The first train was run on the Melbourne-Flemington electric railway at the end of October; a full service is not expected for several months.

The Legislative Assembly has voted against the nationalisation and State control of the Melbourne tramways.

Queensland.—A scheme for the electrification of the Rockhampton tramways is being prepared by Mr. W. J. S. Jones, consulting engineer, Brisbane.—*Tenders.*

Blackpool.—Proposed Purchase.—The T.C. has unanimously decided to promote a Parliamentary Bill to acquire the property of the Blackpool and Fleetwood Tramroad Co., and to carry out tramway extensions in the borough.

Bristol.—Collision.—A collision occurred between two tramcars at Perry Road, last week, resulting in both cars leaving the line. Ten persons were removed to the infirmary.

Burnley.—At a conference with the T.C. officials, last week, Major G. Stewart, of the L.G.B., stated that the embargo on the borrowing of money had now been removed. The tramway manager stated that £10,000 would be spent on necessary work in connection with the tramways.

Continental.—Switzerland.—The Swiss Federal Railways Administration has been granted a credit of Fr. 16,800,000 for the purchase of 20 electric locomotives, of which sum Fr. 5,600,000 will be regarded as a supplementary credit for the Construction Budget, 1918.—*D.A.Z.*

Germany.—It is announced that the eight-hour day was to have been introduced on the system of the Grand Berlin Tramways Co. on December 15th. It was calculated that if the undertaking was to remain remunerative it would be necessary to raise the fares from the present charge of 12½—15 pf. to 20 pf. (2½d.)

Delagoa Bay.—The report of the Delagoa Bay Development Corporation for the year ended June 30th states that passengers carried on the electric tramways numbered 1,661,429, an increase of 208,736.

London.—Derailment.—The L.U.T. tramway system was disorganised, late on Saturday night, by the derailment of a car at Brentford.

The B. of T. has extended the time for the construction of new works authorised by the L.E.R. Act of 1913, to August 7th, 1919.

All the tramway services of the L.C.C. are to be suspended on Christmas Day, from 4 p.m.

Woolwich.—The B.C. has provisionally approved of the scheme for the construction of a railway on the Kearney system from the Arsenal gates to N. Woolwich Railway Station, a distance of half-a-mile under the Thames.

Motor-Bus Subsidy.—The L.C.C. Highways Committee has issued a report on the Government subsidy paid to the L.G.O. Co. in respect of its services in South-East London. The grant amounted to £44,312 for the year ended June 30th, 1917, and was made in respect of 17 omnibus routes, 10 of which were in competition with the tramways; the grant was made in order to obtain a good service for the munition workers at Woolwich, but many of the subsidised routes extended to the north and west of London. At a meeting of the L.C.C. on Tuesday, it was stated that the total grant amounted to nearly £100,000, and the opinion was expressed that the Council should receive the same treatment as the L.G.O. Co.

Manchester.—As a result of the recent decision of Mr. Justice Bailhache, at the Assizes, that "a person who gets up in a tramcar before it stops, does so at his own risk," a public announcement is to be made by the Tramway Committee bearing on the Judge's ruling.

Oldham. — Proposed Extensions.—The T.C. has decided to apply to the B. of T. for a prov. order for powers to construct new tramways to the Chadderton and Werneth districts.

Stirling. — Proposed Electrification.—Negotiations are to be reopened by the Stirling and Bridge of Allan Tramways Co. with the T.C. for the purchase of the system by the Council, with a view to its electrification. Failing the taking-over by the T.C., the company will consider the question of the application of mechanical traction.

Tynemouth. — Proposed Purchase. — The T.C. has decided to promote a Bill in the ensuing session of Parliament for powers to construct and work trolley vehicles and omnibuses, and to acquire and work the tramway system.

United States.—A charge of manslaughter is being brought against the president, four officers, and a driver of the Brooklyn Rapid Transit Co., in connection with an accident on November 1st, reported in this column at the time, in which 85 persons were killed. The accident occurred during a strike, and was alleged to have been due to the inexperience of the driver.

TELEGRAPH AND TELEPHONE NOTES.

Australia.—With further reference to our note on November 8th, it is stated by the Sydney evening Press that Mr. Jensen, Federal Minister of Customs, who had resumed his position in the Cabinet, after an investigation into a war purchase of a wireless station, finally gave up his portfolio on a threat by Mr. Watt, Acting Prime Minister, that otherwise the whole Cabinet would resign.—*The Times.*

Telegraphic Delays.—*The Times* states that complaints have been received from business houses recently regarding the delays which are experienced in the transmission of cable telegrams. Messages to India take five to six days, and deferred cables 10 to 15 days sometimes, while messages at ordinary rates between London and Australia take four to six days to arrive, and those at deferred rates six to nine days. In view of the congestion of traffic, which apparently is the cause of these delays, it is suggested that the list of approved codes should be extended. This would reduce the enormous expense which is at present thrown on commercial houses, which have to pay ordinary rates for messages delivered at about the same speed as week-end messages in pre-war days. It would also reduce the congestion. If the freer use of codes cannot be allowed, it is suggested that the cable companies should reduce the rates they charge for ordinary messages, which take so long to reach their destination, to the rates quoted for deferred messages.

United States.—Mr. Moon, Chairman of the Post Office Committee of the House of Representatives, has introduced a Bill for the permanent Government ownership of the telegraph and telephone lines as auxiliary to the Post Office Department. The Postmaster-General states that President Wilson is in favour of the measure. The Bill authorises the purchase of the telephone systems and a preliminary survey of telegraphs.

Mr. Carlton, president of the Western Union Telegraph Co., has been placed in charge of the submarine cables of the country.—*The Times.*

Mr. Vail, the president of the American Telegraph and Telephone Co., announces a new multiplex installation which enables one wire to do the work of 10 used heretofore. A pair of wires carries five conversations simultaneously, or 40 telegraph messages.

A joint resolution has been introduced in the House of Representatives continuing the control by the Government of telegraph and telephone systems until otherwise ordered by Congress.

The Commercial Cable Co. has taken legal steps to prevent the American Postmaster-General from retaining, operating, or amalgamating any other line with its concern. The Postmaster-General nominated Mr. Geo. G. Ward, vice-chairman of the company, as manager of the joint system, but Mr. Ward refused to act. Ex-Judge Hughes, who represents the company, contends that the signing of the Armistice deprives the Government of the power to make further seizures, and that Government control is now inoperative, except for winding up matters.

Wireless Operators.—Inquiries made by *The Times* indicate that during the next few months, at least, the number of applications for employment as wireless operators will far exceed the number of vacancies occurring. In addition to the men coming from private wireless schools, there will be a very large number released from the Navy and Army who will seek employment with the Marconi Co., and who will, in all likelihood, be given preference. The company has about 400 of its own men whom it has lent to his Majesty's Forces, who will be returning probably within the next three or four months, and at the present moment the company has 106 applicants, all men with first-class certificates on the waiting list.

Wireless Telegraph Invention.—Our American contemporary, the *Electrical Review*, of November 23rd, contains a statement issued by Mr. E. J. Nally, general manager of the Marconi Wireless Telegraph Co. of America, of considerable importance. We learn that Mr. R. A. Weagant, chief engineer of the company, just before the entry of the United States into the war, had made a discovery whereby the trouble due to the interference of static electrical disturbances was completely eliminated, while the use of tall towers and elevated antennæ was rendered unnecessary, and interference between adjoining stations was obviated. No details are disclosed. The invention was placed at the disposal of the United States and the Allied Governments, and is being adopted in all the Marconi high-power stations; it will render long-distance wireless communication continuous throughout the 24 hours of the day, regardless of the atmospheric conditions.

CONTRACTS OPEN AND CLOSED.

OPEN.

Australia.—Sydney.—April 28th. City Council. Supply and erection of power house switchgear. Specifications from Electric Lighting Department, Town Hall, Sydney.

Victorian Railways Department.—January 15th. Supply of battery cells. Particulars from Agent-General for Victoria, London, S.W.

Dublin.—December 23rd. Electric Supply Committee. 200 single-phase and 100 three-phase, A.C. meters. See "Official Notices" to-day.

Manchester.—Electric passenger lift. Particulars from R Cheetham & Co., 25, George Street.

New Zealand.—Wellington.—January 6th. Public Works Department. Electric current transformers. Copies of the schedules, &c., may be seen at the Inquiry Office of the Department of Overseas Trade (Development and Intelligence), London.

Sheffield.—January 7th. Corporation Tramways and Motor Committee. 50 double-decked top-covered vestibule tramcar bodies with trucks. Mr. A. R. Fearnley, General Manager, Division Street.

Spain.—The municipal authorities of Puente Genil (Province of Cordoba) have lately invited tenders for the concession for the electric lighting of the town during a period of ten years.

CLOSED.

Glasgow.—The Electricity Committee has recommended the Corporation to accept the tender of Messrs. Babcock & Wilcox, Ltd., at £140,282, for the equipment of the second boiler house at the Dalmarnock station, consisting of eight boilers and accessories.

E.C. recommended :—

Handrails on gangway and ladders at the Dalmarnock station, £1,115.—Messrs. Donald Clark, Ltd.

Rolled steel beams for turbine room floors, £3,441.—Messrs. P. & R. Fleming.

Steam piping, £.83.—Messrs. Stewart & Lloyds, Ltd.

Norway.—The Norske Aktiebolag Elektro-Kemisk Industrie, of Christiania, has lately placed a contract with Messrs. Piccard-Pictet & Co., of Geneva, Switzerland, for the supply of a Pelton turbine, of 12,000 H.P. capacity, for its new hydro-electric generating station.

Wolverhampton.—T.C. Additional payments in respect of contracts owing to revision of labour rates and increased cost of material :—

Willans & Robinson.—5,000-kw. turbo-alternator set, £650.

Ferguson, Pailin & Co.—Reactance sets, £20.

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, December 20th. At 7.30 p.m. At the Royal Society of Arts, John Street, Adelphi, W.C. Presidential address: "What War has done for Engineers, and the Part Engineers will have to play in Reconstruction," by Col. R. E. B. Crompton, C.B.

(Midland Section).—Friday, December 20th. At 7.45 p.m. At the University, Birmingham. Paper on "The Manufacture of Cast-iron Pipes," by Mr. T. E. Dimbleby.

(Sheffield Section).—Friday, December 20th. At the Cutler's Hall. At 7.30 p.m. Ordinary meeting.

NOTES.

Institution and Lecture Notes.—Institution of Electrical Engineers.—At the meeting of the Institution held on Thursday last week, the president (Mr. Wordingham) read a letter from Mr. Robert W. Paul, M.I.E.E., offering a sum of £500 to found a premium for the best paper read before the Institution on the subject of electrical measurements and measuring instruments, as an encouragement to young engineers to take more interest in the subject. The Council accepted the offer. Mr. Wordingham also read a most interesting document dated London, 1871, for which the Institution was indebted to Mr. A. H. Preece, M.I.E.E., touching on the foundation of the Society of Telegraph Engineers. Referring to the destruction by the enemy of libraries in Serbia, the president announced that the Council had decided to make a donation of £50 and a set of bound volumes of *Proceedings* of the Institution dating back 20 years, towards the re-establishment of such libraries. A member of the Council (Mr. L. B. Atkinson) had also offered to give a complete set of bound volumes of *Proceedings* of the Institution of Civil Engineers for the same purpose. The president announced that arrangements were being made to celebrate Peace by some suitable function to take place in the early summer. It had also been decided to re-establish the annual Institution dinner, which would probably be held about April next.

Royal Institution of Great Britain.—Friday discourses at 5.30 o'clock :—

January 17th.—Prof. Sir James Dewar, F.R.S., "Liquid Air and the War."
February 28th.—Prof. J. A. McClelland, D.Sc., F.R.S., "Nuclei and Ions."
March 7th.—Prof. H. C. H. Carpenter, F.R.S., "The Hardening of Steel."
March 28th.—Sir John H. A. Macdonald, F.R.S., M.I.E.E., "The Air Road." (Illustrated.)
April 11th.—Prof. Sir J. J. Thomson, O.M., Pres. R.S., "Piezo-Electricity and its Applications."
"Study of Electric Arcs and Their Applications," by Prof. J. T. MacGregor-Morris, M.I.E.E., East London College. Two lectures on Tuesdays, February 4th, 11th.
"Clutches," by H. S. Hele-Shaw, D.Sc., F.R.S. Two lectures on Tuesdays, March 4th, 11th.
"Spectrum Analysis and its Application to Atomic Structure." By Prof. Sir J. J. Thomson, D.Sc., Pres. R.S. Six lectures on Saturdays, March 8th, 15th, 22nd, 29th, April 5th, 12th.

Junior Institution of Engineers.—The current number of the *Journal* contains an account of the annual general meeting, at which the chairman stated that 28 members of the Institution had fallen in the country's service. The accounts showed an excess of expenditure over income for the year of £126. The benevolent fund stood at £359.

Keighley Association of Engineers.—A party of 120 connected with this Association was shown round the works of the Phœnix Dynamo Co., Ltd., Bradford, last Saturday week.

Association of Mining Electrical Engineers.—At a meeting of the Yorkshire Branch, at Leeds, on December 14th, Mr. J. R. Haigh read a paper on "The Electrification of Old Collieries." He referred to pits 40 or 50 years old, a great many of which, he said, were working under conditions that were not conducive to efficiency, but at which the expenditure of a few thousand pounds would repay itself in a few years, and would afterwards yield a good dividend for the shareholders. Taking a colliery with an output of 1,200 tons per day, and winding engines of 1,100 H.P., he estimated that the amount of steam wasted would give 2,390 KW. of electricity. He proceeded to show in detail how this could be utilised, and how it had been utilised at the colliery with which he was connected.

Birmingham and District Electric Club.—At the annual meeting of this club the following officers were elected for 1919 :—

President ...	...	Mr. W. H. Varnom (Donovan & Co., Birmingham).
Vice-Presidents	...	Mr. H. W. Wolton (H. James & Co., Smethwick) and Mr. A. C. Wynne (Wandsworth Electric Manufacturing Co., Birmingham).
Treasurer ...	...	Mr. A. E. Cunningworth (Buttons, Ltd., Birmingham).
Secretary ...	...	Mr. N. Deykin (Berry's Electric, Ltd., Suffolk Works, Birmingham).

The headquarters of the club have been removed to the Grand Hotel, Birmingham.

The secretary (Mr. N. Deykin) was re-elected for the fifth year in succession, and was presented by the old members of the club with a pair of handsome three-light candelabra and a tankard suitably inscribed.

Patents and Alien Enemies.—A B. of T. Order in connection with patents in respect of which licences have been granted by the B. of T. or the Public Trustee by virtue of the Patents, Designs, and Trade Marks (Temporary Rules) Acts, 1914, and the Trading with the Enemy Amendment Acts, 1914, and 1916, states that in the event of the renewal fees not being paid by the patentees, such fees may be paid by the licensees. Application for permission to pay such fees must be specially made to the Comptroller-General of Patents, Designs, and Trade Marks.

Electric Cooking in Railway Trains.—The danger of cooking with gas fires on railway trains has been shown by the disastrous effects in recent railway accidents in Germany. As a consequence, the Association for Promoting the Utilisation of Electricity has taken steps to co-ordinate the efforts of manufacturers, public bodies, and other interested parties to secure early tests with the object of introducing electric cooking on the German restaurant cars.

The Dilutee.—According to a statement appearing in *The Times*, a Joint Conference of employers and employés in the engineering, shipbuilding, and allied trades, on Tuesday, discussed questions of importance in regard to the future administration of these industries. It seems that the vexed question of the dilutee—whether he or she should now give place to the skilled man returning to take up his original job—was dealt with, and the matter stood adjourned until next week.

Mine Cables.—To obviate fire and other risks to miners consequent upon the presence of transmission cables in the operating shaft, the Anaconda Copper Co. has driven 3½-in. diamond drill holes through solid rock to provide for carrying electric cables to the 1,200, 2,200, and 2,800 ft. levels for operating pumps, blowers, and fans. The cable is three-conductor 400,000 circ. mil., with varnished cambric, ¼-in. lead, and 0·18-in. galvanised steel wire. The over-all diameter is 2·03 in., and the weight 16·6 lb. per ft. The cable is suspended from a cable bell at the surface, and the greatest length of cable let down in one piece is 650 ft. The pumping loads supplied on the three levels are about 1,200 H.P., 1,200 H.P., and 900 H.P. respectively.—*Electrical Review*, Chicago.

Plant for Sale.—Bolton Corporation Electricity Committee has for disposal two 2,000-H.P. steam engines, complete with barometric condensing plant and 3-phase, 50 cycles, 6,600-volt alternators. Loughborough Corporation Electricity Department invites offers for one Drybank marine boiler, fitted with Bennis mechanical stoker. For particulars see our advertisement pages to-day.

Proposed Reunion of Divisional Engineers.—In 1914 the Institutions of Civil, Electrical, and Mechanical Engineers assisted in the formation of a unit known as the Divisional Engineers, which was attached to the Royal Naval Division. As many of these men are now discharged, or are being demobilised under the present scheme, Mr. C. Saxton is anxious that members of the original No. 3 Section of the 1st Field Company should communicate with him at the United Glass Bottle Manufacturers, Ltd., care of Nuttall & Co., Ltd., Ravenhead, St. Helens, Lancs. Mr. Saxton and several others are very anxious to get in touch with as many of the original men as possible, with a view to making arrangements for a reunion.

Inquiries.—Mr. W. H. Miller, electrical engineer, of Fleetwood, has in use in connection with prepayment meters several snap locks, the keyhole of which is covered, when locked, by a paper seal, duly initialled, on the back ; the insertion of a key destroys the seal. The lock is stamped, "Tourtel's Patent." Mr. Miller would be glad if any other engineer using these or similar locks would kindly inform him where they can be obtained.

Appointments Vacant. — Electrical plant attendants (72s. 6d. + 12½ per cent.), for R.E. Lighting Plants, near Plymouth ; two switchboard attendants (68s. 6d.), for the Burnley Corporation Electricity Works ; telephone electrician for the Birmingham Corporation Tramways ; distribution superintendent (£300), for the Wolverhampton Corporation Electricity Department ; chief clerk (temporary), for the Rhondda U.D.C. Electricity Department ; switchboard attendant (62s. 3d.), for the Lancaster Corporation Electricity Works ; shift engineer (£208), for the Tunbridge Wells Corporation Electricity Department ; assistant instructors, (part time) in electrical engineering and installation and maintenance work, for the Croydon Central Polytechnic. See our advertisement pages to-day.

Electrical Tides.—*Le Génie Civil* of October 26th contains a note by M. Branly on M. Marc Decheverens's observations, made from October, 1917, to August, 1918, at the St. Louis Observatory at Jersey. We learn that the two underground pipe systems which supply the Observatory with gas and water, on being connected through a sensitive galvanometer, indicated the existence, through the earth, of an E.M.F. of 0·1 volt, the variations of which have been registered photographically during the past two years. The current was manifestly affected by the moon, not directly, but through the contraction of the oceanic tides. In effect, twice each day the voltage reached a maximum value and twice a minimum value. The duration of a complete variation was about 25 hours, solar time, the maxima and minima for the day being recorded 50 minutes later than the day before, lagging behind the daily tide. The influence of the highest tide is not apparent until after an interval of 40 hours 30 minutes. It was found that the greatest variation of the E.M.F. at that particular time was recorded as a minimum voltage about 38 hours 30 minutes after the new moon, or two hours before the highest tide of the year. These and other observations by M. Decheverens lead to the supposition that there may exist, on every seashore, underground electric tides caused by, and following the essential features of, the oceanic tides.

Electricity on the Farm in Southern California.—The actual use of electricity on the farm is best gauged by the agricultural load reported by the Southern California Edison Co. The president of the company reports the increase of foodstuffs to the amount of $21,000,000 a year as the result of bringing 75,000 acres of arid land under production by electric irrigation during the past year. A total expenditure of $5,614,581 for new properties was necessary in order that the company and its subsidiaries could, during 1917, increase the production of hydro-electricity and provide transmission and distribution lines, in a region of 50,000 sq. miles, to meet the demands of new business chiefly created by agriculturists, who are complying with the policy of the Government in increasing the food supply.

Training Disabled Men for Electrical Work.—The Kent County Council is training disabled soldiers in electrical engineering at Erith, and subjoined are the results of the first batch of men who have had the six months' course, the words in brackets being the pre-war occupations of the men :—

Number beginning course, 16. Number placed, 12.

Number not completing course, 4 (one owing to illness, three owing to inability to understand the work).

Assistant in power house in engineering works, £3 per week (Army).

General electrician, 1s. per hour (Army).

Assistant in electrical test-room, 1s. per hour (labourer).

" " " 1s. per hour (Army).

" " " 1s. per hour (printer).

2nd Class examiner in Royal Dockyard, testing of manufacturers' instruments, &c., 55s. per week (kinematograph operator).

Inspecting in Royal Dockyard, 55s. per week (joiner).

3rd Class examiner in Royal Dockyard, 42s. per week (farm labourer).

Instrument test-room assistant in Electric Co., 1s. per hour (chauffeur).

Repairing and assembling motors and dynamos, £2 14s. 6d. per week (clerk); ditto (farm labourer); ditto (colt-breaking, rough riding).

The A.S.E. Chairmanship.—By an overwhelming majority, Mr. J. T. Brownlie was elected chairman of the Amalgamated Society of Engineers, in the recent ballot.

Volunteer Notes.—The Headquarters of the Royal Engineers, Volunteers, London Army Troops Companies, will be closed from Monday, December 23rd, to Saturday, December 28th.

Blowing Air into Electric-Furnace Steel.—Constant progress is being made in the means and methods of producing electric steel. The latest advance is a process for which a patent has been granted to Ernest Humbert, an American engineer, for blowing air into the solid charge of the furnace. After the furnace has been tapped, and any necessary repair to banks and bottom has been made, it is charged with scrap. This immediately absorbs heat from the lining. By the time the principal portion of the charge is in the furnace, the lower part will have become incandescent. The electrodes are then lowered and the current is turned on. Air is led into the incandescent part of the charge, at any convenient pressure, through a 1-in. pipe connected to a flexible hose. The carbon-monoxide formed at the point where the air strikes the metal is converted at once into carbon dioxide, burning with a white flame, and melting the charge very quickly. The pipe is raised from time to time to keep the air playing on the solid portion of the metal until all is melted. The oxygen in the air, by oxidising the carbon, silicon, and phosphorus, causes a great rise in temperature, thereby reducing the melting time. By using this process the time saved on each heat is from 25 to 50 per cent., varying with the composition of the charge and the metal to be produced. This means a saving of 175 to 350 KW.-hours per ton of metal produced.

Silvering Glass Mirrors.—In the ordinary process of silvering glass mirrors by chemical decomposition the metal is deposited upon the glass container. In this manner a great deal of silver which might have added to the thickness of the mirror is lost. This is an important item when silvering mirrors 25 cm. or more in diameter.

A note appears in *Science* of October 4th, from Mr. W. W. Coblentz, of the Bureau of Standards, calling attention to the usefulness of ordinary "granite-ware" enamelled iron pans, which do not attract the silver, and hence increase the supply of material available for deposition on the mirror. During the past year he has had frequent opportunties to verify this observation and to apply it in producing thick deposits of silver on glass.

Those German Scientists.—The *Times* correspondent at Brussels says that the Belgian Surgical Society, at its first meeting since July, 1914, solemnly repudiated the notorious defamatory manifesto of 93 German *savants*, and resolved to break off all relations with German scientists until the calumnies, especially against Belgian medical men, are publicly disavowed.

An Armistice Soirée.—In order to celebrate the signing of the Armistice, a soirée, concert, and dance was held on Wednesday evening, 18th inst., in the Council Chamber at Caxton Hall, Westminster, by the Designs and Production Drawing Office Staff of the Tanks Department of the Ministry of Munitions. The chair was taken by Lieut. F. B. Shaw, the vice-chairman being Mr. F. G. Wiles (chief draughtsman), while the organising committee consisted of Mr. A. G. Sanders, M.I.E.E., Mr. A. Stapley, A.M.I.M.E., Mr. C. J. Stenholm (acting M.C.), and Miss Mercer. The company numbered about 150, and included some well-known members of the civil, mechanical, electrical, and motor-car professions.

Fatality.—While moving an electric radiator used for drying plaster at Messrs. Osborne, Graham & Co.'s shipyard, Hylton, Sunderland, J. E. Berry (17), received an electric shock, and was killed instantly.

A Technical Union in Poland.—According to the *Dziennik Poznanski* (November 13th), at a meeting held in Posen on November 11th, 30 Polish architects, engineers, and technicians decided to form themselves into a Wielkopolski (Duchy of Posen) Technical Union, which will be the one Polish institution in the Prussian partition to settle questions of architecture, land surveying, communication, road and bridge making, chemistry, machinery, and shipbuilding.

Engineers in the Académie des Sciences.—On the proposal of M. André Blondel, a division of the Académie has been formed which is reserved for engineers, and represents science applied to industry. The first election has taken place, resulting in the choice of M. Maurice Leblanc by a large majority. Five other engineers remain to be elected to complete the new division, which it is hoped will exercise a favourable influence on the alliance of science with industry.—*Génie Civil.*

Electroculture.—A Sub-Committee of the Chester Corporation has been appointed to supervise experiments made by the electrical engineer (Mr. S. E. Britton) in the development of electricity as an aid to agriculture.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station and Tramway Officials.—Mr. W. R. MURRAY, assistant engineer at Ayr Corporation electricity works, has been appointed head engineer at Stirling electric station. There were 112 applicants.

Shoreditch B.C. Electricity Committee recommends that the salary of Mr. C. N. RUSSELL (borough electrical engineer) be increased from £825 per annum (which includes a war bonus of £75) to £1,000 per annum, inclusive of war bonus and all other existing emoluments; that the salary of Mr. W. S. CLARK (electricity department) of £330 per annum, which includes a war bonus of £30, be increased to £400 per annum, to be inclusive of war bonus.

Mr. A. E. MCKENZIE, M.I.E.E., deputy chief engineer to the Manchester Corporation electricity department, has resigned his position in order to join the staff of Messrs. C. P. Sparks, consulting engineers, of London. Mr. McKenzie has been in the service of the Manchester Corporation for the past 17 years.

The Bridlington Electricity Committee has increased the salary of Mr. F. FFRENCH, deputy electrical engineer, from £185 to £235, to include all bonuses, and has granted him £25 in lieu of eight weeks holiday.

General.—Mr. C. H. WORDINGHAM, C.B.E., who since 1903 has been head of the Electrical Department of the Admiralty, and, as such, responsible for the design and supervision of the construction and completion for service of the electrical equipment of all H.M. ships, as well as for advising on all important questions of electric lighting and power in connection with dockyards and other naval shore establishments, has resigned his appointment as Director of Electrical Engineering in order to return to consulting practice. His address after January 1st next will be 7, Victoria Street, Westminster, S.W.1. Mr. Wordingham has been retained by the Admiralty to continue acting in an advisory capacity. In our issue of October 19th, 1917, we gave a biographical sketch of Mr. Wordingham, and as we then said: "His was the great responsibility of the design and supervision of contracts for the electrical equipment of all His Majesty's ships, and he has had the unique experience of having seen his designs and arrangements satisfactorily withstand the supreme test of action with the enemy." To this we may now add that the final victory, complete and overwhelming, has set the seal of success upon his great work; he completely reorganised the electrical engineering practice of the Admiralty, and seeing that a warship over 15 years old is practically obsolete, we may safely say that every vessel of the Royal Navy which was engaged in the war bore the marks of his handiwork. Thus Mr. Wordingham leaves his high position with the consciousness of having rendered eminent service to the State; he has not lost touch with civilian interests during his stay at the Admiralty, and we hope, not doubtfully, that he will be no less successful in his new sphere of labour. In view of the peculiar methods of the Government in distributing honours, which rarely fall to the lot of distinguished engineers, it may appear too optimistic for us to anticipate that the President of the Institution will receive appropriate recognition for his national services; but that such recognition has been richly earned will be acknowledged by all who know something of his indefatigable activities both in naval and civil affairs pertaining to the electrical industry.

In view of the recent rapid progress of events affecting British engineering industry and the export trade, the Council of the British Engineers' Association, in order to cope with the vast amount of important work which will devolve upon it in the immediate future, has decided to strengthen its administration by the appointment of a director, who will be the chief organising and executive officer of the Association. To fill this responsible position the Council has secured the services of Mr. D. A. Bremner, O.B.E., who, as an engineer, business organiser, and administrator has had a wide experience at home and abroad. Mr. Bremner will assume his position on January 1st next.

Mr. CLIFFORD C. PATERSON is terminating his appointment at the National Physical Laboratory, Teddington, and is joining the General Electric Co., Ltd., as director of research

laboratories as from January 1st, 1919. Pending the erection of the necessary laboratory buildings, the temporary offices and address of the research laboratories of the General Electric Co., Ltd., will be at the Osram-Robertson Lamp Works, Hammersmith, London. Mr. Paterson is one of the Principal Assistants of the Director of the Laboratory, in the Physics Department, and has been at the head of the "Electrotechnics" Branch, in which capacity he has been responsible for investigations covering a wide range of subjects, especially in connection with photometry, in which his work has attained world-wide reputation. He has also been continuously engaged in carrying on the routine testing of instruments, &c., which constitutes a large proportion of the work of his department, and with his colleagues has developed many novel devices and processes of great value to the electrical industry. In his new post he will have an ideal opportunity for organising a research department on the most up-to-date lines, and we congratulate him on his taking up a task so thoroughly congenial, interesting, and useful to the national industries.

Sir WILLIAM MAXWELL, formerly Director-General of Indian Posts and Telegraphs, has retired from that appointment, says *Indian Engineering*.

According to a New Zealand paper, Mr. EVAN PARRY, the chief Government electrician, has resigned. An offer of double remuneration did not induce him to withdraw his resignation.

Mr. ERNEST HOTOPF-HOLDEN has returned to England after four years' internment at Ruhleben Camp, Germany. Previously he was the foreign representative of the Morgan Crucible Co., Ltd., Battersea, resident in Berlin, and he expects to resume work for that firm early in the New Year.

The Board of Trade have appointed Sir JOHN SNELL to act as their adviser on all matters arising out of the report of the Electrical Power Supply Committee.

Mr. A. G. WARREN, assistant electrical inspector, has been appointed electrical inspector to the Indian Government, United Provinces, from September, 1918, vice Mr. Bell, who has returned to the Municipal Board, Mussoorie.

The *Manchester Daily Dispatch* reports that the Manchester District Engineering Trades Employers' Association, at the annual meeting on Tuesday, elected Mr. H. MENSFORTH, of the British Westinghouse Electric & Manufacturing Co., Ltd., as president. During the war period he has been chairman of the Manchester and District Armaments Output Committee.

On Monday last Mr. L. V. HAMBLIN, the Birmingham manager of the B.E. Co. (of London and Birmingham), Ltd., was married to Miss N. J. Tallis, of Moseley, at the Parish Church, Yardley Wood. Mr. L. V. Hamblin, who has been with the firm for 12 years, was the recipient of many handsome presents. The departmental heads in London and Birmingham gave a dining-room clock and a cutlery cabinet, suitably inscribed, these being presented by Mr. C. D. Falcke, A.M.I.E.E., the managing director of the B.E. Co. (of London and Birmingham), Ltd.

Roll of Honour.—Second-Lieutenant the Hon. E. F. FRENCH, R.F.A., who died in November from influenza, at a prisoners' camp, aged 32 years, matriculated at London University, and, according to the *Times*, became a student at Faraday House, afterwards working in Mexico and the U.S.A.

Lance-Corporal J. A. CHALLIS, who has died at Alexandria from malaria, was formerly engaged at the Marconi Works at Chelmsford.

Corporal G. H. WALKER, R.E., who has died in France from pneumonia, was trained for electrical engineering at the works of Messrs. Mather & Platt, of Manchester, and was awaiting his discharge to enable him to take up an appointment at Liverpool.

Private J. DUNN, Gloucestershire Regiment, who has been killed in action, was formerly engaged at the Preston electricity works.

Second-Lieutenant F. A. STRANGE, Royal Berkshire Regiment, who has gained the Military Cross for gallantry and devotion to duty, was on the electrical staff of Messrs. Strange & Sons, Ltd., of Tunbridge Wells.

Private A. W. BENNETT, R.A.M.C., who has died of pneumonia at Salonika, was previously employed at the Manchester Corporation electric power station, Clayton.

Private A. E. RICHARDS, King's Liverpool Regiment, who has died of wounds, was employed in the electricity department at the Manchester Town Hall.

Sergeant J. HAWORTH, D.C.M., South Lancs. Regiment, who died of wounds whilst a prisoner of war in Germany, was employed at the Manchester Corporation electricity works.

Private S. FLETCHER, Durham L.I., who has been killed in action, was formerly with Messrs. Sykes & Sugden, electrical engineers, of Huddersfield.

Corporal W. RASTRICK, West Yorks. Regiment, who has been awarded the Military Medal, was formerly with Messrs. Barraclough Bros., electricians, Brighouse.

Private H. EDGECOMBE, Argyle and Sutherland Highlanders, formerly in the general office of the India-Rubber Co., Silvertown, has been awarded the Military Medal.

Obituary.—HERR W. LINKE.—The death is announced from Berlin, as the result of a railway accident, of Herr W. Linke. The deceased, who was only 38 years of age, was one of Germany's coming men in the field of wireless telegraphy, and was associated with the business of the Electrizitats Gesellschaft vorm. H. Poege, of Berlin.

MR. E. J. HOUGHTON.—We regret to learn that Mr. E. J. Houghton, formerly electrical engineer of the L.B. & S.C. Rly. Co., passed away at his residence at Croydon on 16th inst., aged 74 years. Mr. Houghton retired from the railway service in September, 1909, after more than 50 years' service, during 34 years of which he held the position of chief electrical engineer of the company. He was the pioneer of electric train lighting in this country, a train equipped with the system he designed having first run between London and Brighton in the year 1881.

Wills.—Mr. THOMAS DENCE, a director of Johnson and Phillips, Ltd., and other companies, left £916,672 gross, and £868,340 net personalty.

Mr. H. C. WATERS, who was a director of the Vera Cruz Electric Light, Power & Traction Co., Ltd., and other companies, left £101,957.

NEW COMPANIES REGISTERED.

Boucher Bros., Ltd. (152,198).—Private company. Registered December 11th. Capital, £6,000 in 5 000 pref. shares of £1 each and 20,000 founders' shares of 1s. each. Electrical and mechanical engineers, motor and aeroplane manufacturers, &c. First directors: H. Boucher, 180, High Street, Redcar, Yorks; P. J. Boucher, 16, Gainsboro' Mansions, Queen's Club Gardens, S.W. Registered office: 16, Regent Street, S.W.

B. Wortman & Son, Ltd. (152,187).—Private company. Registered December 10th. Capital, £10,000 in £1 shares (4,000 7½ per cent. cum. pref.). To take over the business of an aircraft manufacturer carried on by B. Wortman; also to carry on the business of electrical engineers, &c. The subscribers (each with one share) are:—B. Wortman, 42, Waterloo Street, Hammersmith, W. 6, aircraft manufacturer; L. Jacobs, B.Sc., &c., 21, Hayes Court Mansions, S.E. 5. First director: B. Wortman. Registered office: 42, Waterloo Street, Hammersmith, W. 6.

High-Temperature Generators (1918), Ltd. (152,217).—Registered December 12th. Capital, £150 000 in £1 shares. To take over the business of a company of similar name, and to carry on the business of engineers, manufacturers of appliances for transmitting heat by superheating or otherwise, electrical engineers, &c. The subscribers (each with one share) are:—C. Breambery, Monument Buildings, E.C., master mariner; L. J. Davis, 5, Talbot Road, W. 13, chemical agent; J. J. Bond, 93, Park Avenue South, N. 8, merchant; J. L. Bolton 85, Brigstock Road, Thornton Heath, Surrey, gentleman; Amy Bolton, 24, Harberton Road, N., clerk; R. England, 77, Wool Exchange Building, E.C., chemical agent; J. R. Johnson, 54, Old Broad Street, E.C. 2, clerk. Minimum cash subscription: Seven shares. First directors: S. Wickens and W. H. Manning.

Universal Valve Co., Ltd. (152,240).—Private company. Registered December 13th. Capital, £25 000 in £1 shares. Manufacturers of and dealers in valves and valve fittings for engines, machinery, motors, motor cycles and vehicles, and for power, lighting, heating, and general purposes, &c. The subscribers (each with one share) are:—C. J. Withington, 29, Bowyer Road, Saltley, Birmingham, accountant; H. C. Chambers, Kerri, Blakesley Road, Yardley, Birmingham, secretary. First directors: H. Jelley and C. Sangster. Solicitors: Pinsent & Co., Birmingham.

McWhirter & Sons, Ltd. (10,177).—Private company. Registered December 4th, in Edinburgh. Capital, £10,000 in £1 shares (3,000 pref.). To acquire the business of electrical and mechanical engineers and electricians carried on by William McWhirter & Sons at Holm Street, Glasgow. The subscribers (each with one ord. share) are:—W. McWhirter, 17, Douglas Street, Glasgow, electrical engineer; A. S. McWhirter, 17, Douglas Street, Glasgow. First directors: W. McWhirter, A. C. McWhirter, and A. S. McWhirter. Registered office: 17, Douglas Street, Glasgow.

British Spiro Turbine, Ltd. (152,171).—Private company. Registered December 9th. Capital, £50,000 in £1 shares. To acquire from Sir W. E. Garforth the benefit of a patent relating to rotary engines and the like, and to carry on the business of engineers, manufacturers of and dealers in steam, oil, gas, and electrical engines, manufacturers of coal-cutting and conveying machines &c. The subscribers (each with one share) are:—Sir W. E. Garforth, Snydale Hall, Pontefract, colliery owner; Capt. G. M. Bles, Beechwood, Knutsford; J. Lithgoe, Rawnscliffe, Wakefield, general manager; T. Boardall North View, Altofts, colliery correspondent. First directors: Sir W. E. Garforth (permanent director and chairman), Capt. G. M. Bles, J. Lithgoe, and T. Boardall. Registered office: City Chambers, Infirmary Street, Leeds.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Veritys, Ltd.—Mortgage on leasehold house in Birmingham, dated December 2nd, 1918, to secure £400. Holder: J. Ansell, Birmingham.

Engineering Accessories Co., Ltd.—Mortgage debenture dated November 23rd, 1918, charged on the company's undertaking and property, present and future, including uncalled capital, securing £1,500. Holders: T. Hancox, C. B. Lee and H. Beesley, all of Coventry.

Mica and Micanite Supplies, Ltd.—Satisfaction in full on November 15th, 1918, of mortgage dated April 17th, 1918, securing £1,400.

Also registered: Mortgage on leasehold premises at Islington, dated November 15th, 1918, to secure all moneys due from company to Barclay's Bank.

Renew Electric Lamp Co., Ltd.—Particulars of £4,000 debentures created November 28th, 1918, filed, the amount of the present issue being £1,550. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Electro-Mechanical Brake Co., Ltd. (98,276).—Return dated June 28th, 1918. Capital, £30,000 in 2,500 pref. and 27,500 ord. shares of £1 each. 1,500 pref. and 22,500 ord. shares issued; £17,965 paid on 1,500 pref. and 16,465 ord.; £6,035 considered as paid on 6,035 ord. Mortgages and charges: £7,500.

Barsi Light Railway Co., Ltd. (44,589).—Return dated October 29th, 1918. Capital, £300,000 in £10 shares. 26,000 shares issued; £260,000 paid. Mortgages and charges: £140,000 4 per cent. debenture stock and £130,000 Latur Extension debentures (part of £125,000 issued, £4,100 having been redeemed).

CITY NOTES.

Western Telegraph Co., Ltd.

Sir J. Denison Pender, presiding at the annual meeting on December 4th, said that the company was to be congratulated on having surmounted the many war-time difficulties which had occasioned anxiety as to the maintenance of communication. These included the restriction of shipping, the supply of material and stores to their many stations, delays and danger to repairing steamers in restoring interrupted cables, transport of staff, &c. The revenue from messages, &c., for the year showed an increase of £392,000, but the ordinary expenses and those for cable maintenance advanced by £131,000, and income tax and excess profits duty by £236,000, so that the big surplus fell to £25,000. Letters had been received from shareholders suggesting that some part of the reserve funds should be distributed to the proprietors in the form of "bonus shares." As foreshadowed at the last meeting, the company had now been granted a concession by the Brazilian Government to lay a submarine cable from Rio de Janeiro to the Island of Ascension, where it would join their other cables landing at that island; also they had secured a concession to lay a cable from North Brazil to the Island of Barbadoes. The length of these new lines together would be considerably over 3,000 nautical miles, and would entail an expenditure of many hundreds of thousands of pounds. Furthermore, since war was declared it had been impossible to carry out renewals to the several existing sections which were now urgently in need of renovation, proved by the constant interruptions to which they were subject. These renewals had to be suspended over the last four years, and time had shown the necessity of resuming this work at once, in spite of the high prices which at present prevailed for cables. They were also threatened with further competition; the Western Union Telegraph Co. had secured a concession to lay cables between various ports from the north to the south of Brazil, thus making another communication between Brazil and the United States. The Central & South American Cable Co., which for many years past had owned cables and land-lines from the United States to the Argentine, had also obtained a decree from Brazil sanctioning the laying of two cables to the River Plate, one from Rio de Janeiro and the other from Santos. These cables would connect that company's existing system at Buenos Ayres with its lines serving Chile, Peru, Central and, finally, North America. They were also advised that a few weeks ago a concession for a submarine cable from Rio de Janeiro to Cuba had been granted to an American citizen, but as yet they had no further particulars with regard to this. The necessary steps were being taken by their legal advisers to protect this company's interests where this proposed competition was considered to affect those interests and their concessions. In July last at a meeting of a wireless company the chairman stated that an eminent authority in the United States had expressed to him the opinion that no long-distance cables would ever again be laid, and that, in his view, wireless telegraphy was thoroughly efficient for all telegraphic purposes. This opinion was evidently not shared by North American cable companies, as was proved by the efforts they were making to lay new submarine cables over a distance of many thousands of miles, entailing an expenditure of close upon, if not over, £2,000,000. The directors had, however, no fear but that they would be able to hold their own in the future as in the past, but what he had told them furnished another reason for maintaining the strong financial position in which the company stood at the present time. Under these circumstances he felt sure the shareholders would support the board in declining to consider in any form the issue of bonus shares.

Twice during the war one of the islands where they had a cable station was bombarded by an enemy submarine. The company's buildings were particularly aimed at, but on the first attack no damage was caused. On the second occasion a shell severely damaged a church facing their station, and splinters penetrated the staff quarters, going through the floor and ceiling of two rooms which fortunately were unoccupied at the time. Several people were killed and wounded, but no member of the staff or their families were amongst the number. At another island where the company's office was also close to the sea an enemy submarine appeared actually in the harbour and did considerable damage to shipping, but no bombardment of the town took place. The staff throughout remained cool and resourceful. Arrangements had been made in 1914, after the war broke out, for the maintenance of communication, even if their buildings here or abroad had been wrecked. The staff, seniors and juniors, at home and at all their foreign stations, had had no easy time during the last four and a half years.

The delay in transmission was regrettable, especially at a time when expedition in Press and commercial telegrams was of even more importance than in normal times, but this was a matter which had been beyond their power to rectify. He, however, now looked forward, if they could only get favourable weather for their ships, which were all at their posts ready to effect repairs, to reduce this delay very materially before the close of the present year.

German Companies.

The Rheinische Elektrizitats A.G. (*late Rhein-Schuckert Co.*), *of Mannheim*, records net profits of £50,000 for 1917-18, as against £46,000 in 1916-17. It is intended to pay a dividend of 5 per cent., being the same rate as in the previous year.

The directors of the *Hoch Frequenz Maschinen, A.G. fur Drahtlose Telegraphie, of Berlin*, presenting a joint report for the past four years, state that the large wireless stations for transmarine service had stood the test during the war. It did not appear appropriate to give full information, owing to the political situation, the pending negotiations, and the action instituted in America by the Compagnie Universelle de Télégraphie et de Telephonie sans Fil. After providing for depreciation, the net profits are stated to have amounted to £26,000 in 1915, £27,000 in 1916, and £29,000 in 1917. A dividend and bonus at the rate of 15 per cent. have been declared on the A shares for each of the four years, and 28.8 per cent. on the B shares for each year, but no profits are disclosed for 1914.

The Norddeutsche Kabelwerke A.G., of Neu-Kölln, Berlin, whose share capital of £125,000 is held by the Neu-Kölln municipal council, the Mix & Genest Co., and the Mansfeld Corporation, reports net profits of £18,900 for 1917-18, compared with £18,600 in the preceding year, £13,000 and £11,000 having previously been written off for depreciation in the two years respectively. The directors state that orders are on hand in sufficient volume, especially for export, although in estimating for these the demands since put forward by the workmen and officials had not been taken into consideration. It was therefore not possible to foresee whether, and if so at what time, the orders would be carried out. The dividend for 1917-18 is at the rate of 15 per cent., this comparing with 12 per cent. in 1916-17.

The Rhein Westfalisches Elektrizitats Werk A.G., of Essen, which is the greatest supply undertaking, partly from pit-bank stations, in the West, reports an increase in the turnover from 555,060,000 KW.-hours in 1916-17 to 772,470,000 KW.-hours last year. The directors state that owing to the increased costliness of plant, a contribution of £200,000 was made to the company from public sources, but this did not by a long way suffice for the purpose. Including £200,000 set aside for special depreciation the total amount written off was £900,000 in 1917-18, as contrasted with £204,000 in the previous year. The net profits were £211,000, as against £213,000, and the dividend on the ordinary share capital of £2,500,000 is 8 per cent., a rate which has been regularly paid since 1911-12.

The report of the *Berliner Elektrizitats A.G., of Berlin*, which undertaking is now purely an investment company, states that a syndicate had taken over the shares of £800,000 in the A.E.G., which devolved upon the company from the sale of the Elektro Werke, as it was not intended to retain permanently a large holding in the A.E.G. The gross profits earned in 1917-18 reached £436,000, as against £408,000 in the previous year, and the net profits—no provision being made for depreciation as in 1916-17—were £272,000, as contrasted with £229,000. It is intended to pay a dividend of 10 per cent. on the ordinary capital of £2,205,000, this comparing with 8 per cent., 7 per cent., and 9 per cent. in the three preceding years respectively.

The Zurich Bank for Electrical Undertakings.—The Bank fur Elektrische Unternehmungen, of Zurich, whose extensive interests are of a world-wide nature, has now been compelled to pass the dividend for the year ended June 30th, 1918, owing to the further unfavourable influences exercised by the war on the company's investments. During the years immediately preceding the war the company regularly distributed 10 per cent. on the ordinary share capital, but in 1914-15 and 1915-16 the rate declined to 8 per cent. in each case, and a further decrease to 5 per cent. took place in 1916-17. The net profits, which reached £330,000 in 1913-14, gradually receded to £160,000 in 1916-17, and the total for the past financial year is returned at only £27,000. The directors state that the dividend rates of further companies in which the company is interested had to be reduced in 1917-18, that further losses arose on the dividends and interest receipts in foreign currency on account of the low rate of exchange, and that as a consequence of this reduction large sums had to be written off the assets in foreign currency. It is reported that the principal securities concerned were those held in Italian and Spanish companies and in the German Transmarine Electricity Co.

Allgemeine Elektrizitats Gesellschaft.

The report of the directors of this company, dealing with the financial year 1917-18, states that the degree of activity in all the works was greater than in the preceding year. It was necessary to erect new buildings and make extensions, which were carried out as war work, and the cost had to be defrayed to a large part out of current working. The electro-steel works and the rolling mill works, which chiefly worked up the company's own scrap, were brought into operation, whilst the sales of the aeroplane department increased fourfold. Orders for the Army and Navy were accepted according to the company's capacity, although the sale prices could not be brought into harmony with the constantly growing cost of production. At the same time, preparations had been made for work on peace manufactures in the ordinary departments, and in this connection it was frequently possible with lasting advantage to meet the scarcity of materials by

the use of substitutes in metals, fibres and insulating materials. The organisation in Germany and in those foreign countries which could be reached had worked satisfactorily, and any ousting of the company's manufactures from accessible markets had nowhere taken place. The railway department completed the Merseburg-Muchelon railway section, and as the province of Saxony had now participated in this undertaking the railway would be extended in the new financial year. On the other hand, the work on the A.E.G. high-speed railway at Berlin was limited to the execution of the most difficult construction. An 100,000-volt transmission line from the Zschornewitz power station to Berlin was completed, and the company participated in the formation of a transmission company constituted with the co-operation of the Government of Bavaria. The accounts are abstracted as follows:—

	1916-17.	1917-18.
Share capital	£9,200,000 ...	£10,000,000
Gross profits	2,339,000 ...	3,116,000
General expenses ...	103,000 ...	130,000
Taxes	160,000 ...	249,000
War allowances	507,000 ...	764,000
Depreciation	55,000 ...	170,000
Net profits and balance forward	1,518,000 ...	1,860,000
Directors' fees	34,000 ...	40,000
Bonuses	100,000 ...	125,000
Pension fund	100,000 ...	150,000
War benevolence	75,000 ...	75,000
Dividend	1,150,000 ...	1,400,000
Dividend, per cent. ...	12½ ...	14
Carried forward	59,000 ...	52,000

The rate of dividend was 12 per cent. in 1915-16, 11 per cent. in 1914-15, and 10 per cent. in 1913-14. According to the balance sheet, the loan debt amounts to £5,226,000, as compared with £5,274,000 in 1916-17, and the mortgage debt to £178,000, as against £135,000. The company's liabilities, which rose from £7,300,000 in 1915-16 to £8,400,000 in 1916-17, have further increased to £9,910,000. On the other hand, the company's credit at the banks is stated to have increased from £5,570,000 in 1916-17 to £7,635,000 last year, and the aggregate credits from £10,712,000 to £11,838,000.

Prospectus.—*Morgan Crucible Co., Ltd.*—This company is issuing through the British Trade Corporation, Ltd., £500,000 first mortgage 6 per cent. redeemable debentures (£100 each). The following facts concerning the company's position are set forth in the prospectus:—

The company is the largest manufacturer in the world of crucibles, and the only British manufacturer of carbon brushes for electrical machinery.

The works at Battersea are freehold and cover seven acres. The buildings, plant, and machinery are substantial, up-to-date, and perfectly equipped. The floor space now amounts to 600,000 sq. ft., an area twenty-fold larger than in 1890.

During the war the increased demand for the company's products has necessitated the accumulation and financing of stocks much in excess of those held in the pre-war period. This is illustrated by the fact that the stocks in the company's balance-sheet on December 31st, 1914, stood at £190,902, whilst the corresponding figure on December 31st, 1917, was £689,719 the latter being taken at cost and below market value.

This large expansion has been financed out of funds due to the Government and advances by the company's bankers. These sums have now to be repaid, and the directors have resolved to arrange for the issue above referred to.

The company has, during the period of the war, largely increased its manufacturing plant, and its output capacity is now three times what it was in the pre-war period. The additional expenditure in connection with the expansion has all been charged against revenue.

The list of applications closes to-morrow (Saturday).

Electrical Securities Trust, Ltd.—The report for the year to November 14th states that an opportunity occurred to realise the debentures and "B" debentures of the North Wales Power & Traction Co., and as it was desirable to close the debenture-holders' trust the trustees made arrangements for selling the remaining assets held as security for the debentures to a syndicate or pool. The debenture-holders approved, and on the sales being completed the trustees had in hand £62,834. After meeting fees and expenses, £58,000 was available, and was accepted by the debenture-holders in full discharge and satisfaction of all claims against the trustees or the company. £55 per £100 had already been repaid, and this further distribution gave each debenture-holder repayment of the balance of £45 of his capital and £13 per £100 towards payment of premium and interest. The discharge by the debenture-holders cancelled £20,966 premium and accrued interest. The board are considering the question of winding up the company.—*Financial Times.*

Companies Struck Off the Register.—The following companies have been struck off the Register, and are accordingly dissolved:—

Acro Fire Alarm, Ltd.
Asbestos & Asbestic Co., Ltd.
British Manganese Co., Ltd.
Curative Electricity Co.
Float Electric Co., Ltd.
Light Railway & General Construction Co., Ltd.
Platinum Substitutes, Ltd.
Waterworks, Lighting & Power Investment Corporation, Ltd.

Manx Electric Railway Co.—Year ended September 30th. Receipts £17,554, gross expenditure £11,741. The debit balance on revenue account is now £31,411. Passengers carried 173,005, against 119,683 last year. Debenture interest has been funded by the issue of second debentures.

Provincial Tramways Co.—Year ended September, 1918. Net revenue from local companies, £69,054. After meeting debenture interest, income-tax, and other charges, £12,000 is put to depreciation and reserve, and £15,000 to reserve account for deferred repairs. A final dividend of 10d. per share on the ordinary shares and a bonus of 6d. per share makes 10 per cent. for the year. £7,804 is to be carried forward.

Vulcanite, Ltd.—Net profit, after providing for excess profits duty, £16,344, including £3,252 brought forward. After meeting preference interest, 10 per cent., less tax, is paid on the ordinary shares. In addition, the pref. and ordinary both receive a bonus of 6d. per share.

British Westinghouse Electric and Manufacturing Co., Ltd.—At an extraordinary general meeting held in London on December 12th, the resolutions passed on November 25th were confirmed.

East London Railway Co.—10s. per cent., less tax, is to be paid on the "B" debenture stock for the year.

Marconi International Marine Communication Co., Ltd.—Interim dividend 5 per cent. (1s. per share), less income-tax.

STOCKS AND SHARES.

Tuesday Evening.

The week before Christmas is not noted for activity in Stock Exchange markets, and, although there have been exceptions to this in the past, the present day is evidently not going to prove one of the latter. Business in all the markets is quiet, and the influence of Christmas is felt everywhere. One of the few outstanding features in the electricity departments is a rise in Edison-Swan shares in anticipation of the report. The price was run up from 17s. 6d. to 19s., and even the safer prophets were inclined to revise their earlier estimates of a 5 per cent. dividend, having regard to the nature of the buying. The estimates ranged finally from 5 to 10 per cent., but caution was inclined to place 6 per cent. as the probable maximum, with a strong balance-sheet behind it. It may be the announcement will be out before these notes are, and it would not be very surprising to see the price react after the declaration is made, in conformity with the usual Stock Exchange practice to run up any price in anticipation of a favourable statement, and then, however favourable the statement happens to be, taking profits immediately upon its publication.

Other manufacturing shares are quietly good, and British Aluminiums exhibited a considerable degree of activity, the price touching 39s. before it went back a few pence, leaving it 38s. 9d., and so showing a rise of 3/16 in a fortnight. There has already been noticeable demand for Callenders. The ordinary have risen no less than 12s. 6d. to 10½, and the preference at 6½ are 5s. up. This, of course, has affected the quotations for the new shares, and the ordinary are quoted 9½, the preference 5 5/16. Henleys remain at 2½, at which they have stood since the opening of the market in the new shares, the preference in their case being quoted 4 middle. Some ask why Henleys do not follow the example of Callenders, and raise the dividend rate upon these 4½ per cent. preference. India-Rubber shares maintained their advance to 17½, and British Westinghouse preference continue dull at 2½. Amongst the engineering issues, Babcock & Wilcox have barely budged from 3½, while the activity that characterised the explosives group a week ago has practically evaporated, and the excitement has blown over for the time being.

Disquieting news respecting Mexico has had a depressing effect upon all the securities connected with that country. Instead of a restoration to peaceful conditions, affairs in Mexico seem to be going once more from bad to worse, and no astonishment would be felt if another revolution were to break out. Evidently there is great local dissatisfaction at the government at Carranza. The high hopes which were entertained with regard to the likelihood of the United States taking a strong line in Mexico at the conclusion of the war have given way to a feeling approaching despair of Mexican matters ever mending. This, of course, is a temporary phase, but its influence is marked in all Mexican issues, and the Utilities have suffered, though slightly, with the rest. It is a curious thing that Mexico Tramways 6 per cent. bonds should be quoted nominally higher at 56, though actually the price is more like 54.

Brazilian Tramway, and Brazilian Traction varieties are rather better, although little nominal alteration has occurred in the prices. British Columbia Electric deferred stock has fallen a point. A private letter from Vancouver just to hand speaks of the prosperity which the city is enjoying, although the writer, who is a mechanic, admits that the after-war problems are certain to become pressing in a short space of time. The Argentine stocks and shares are steady, attracting no particular attention, and prices remain unchanged on the week.

Amongst electricity supply shares, the decline to 13 in City of London ordinary is the only quotable change. The rest of the list is well maintained, though perhaps there is not quite so much demand for the shares as there has been just lately. This, of course, is simply due to the fact that investors are holding back their money for window-dressing purposes before the New Year.

In the telegraph and telephone market, Eastern Extensions and Eastern Telegraph ordinary stock have given way to a slight extent, and Westerns at 16½ are about 7s. lower, taking into account the 3s. net dividend deducted from the price a few days ago. Marconis managed to maintain their position pretty well, without there being much activity in their department. Americans have sagged away to 30s. 6d., while Marines remain about 3½, the parent shares holding an even keel at 4½. Great Northern Telegraphs are 10s. higher on the week.

Nationalisation is still the word to conjure with in the railway market. The first blush of enthusiasm over the stocks has suffered, however, a set-back in consequence of profit-taking sales. These were supplemented by realisations on behalf of people who are not inclined to take a particularly rosy view of the chances that the Government will pay such fancy prices as are contained in the estimates worked out by statisticians. Unless the market is supported by a fresh set of buyers every day the tendency of prices is bound to be somewhat breaking. Underground Electric income bonds have shed ½, and the ordinary shares, after rising ¼ up to 3½, reverted to 3¼. Metropolitans are ½ down, but Districts maintain their advance. Unless interest is revived by some fresh official announcement, the inclination will probably be for prices to ease off.

Castner-Kellner shares have given way 3/16 to 3 7/16, notwithstanding the maintenance of the 20 per cent. dividend. Apparently some had hoped for the distribution to be replaced by the 22 per cent. paid for 1916. The rubber market is a shade better on removal of restrictions in the United States. Copper and other base-metal shares have weakened, for the same reasons as mentioned here previously to account for the dulness prevalent in this market for the past month.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1916.	Dividend 1917.	Price Dec. 17, 1918.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	9	10	7½	—	£6 18 0
Charing Cross Ordinary	5	4	3½	—	5 14 0
do. do. do. 4½ Pref.	4½	4½	3¾	—	6 13 4
Chelsea	3	5	4	—	6 5 4
City of London	8	8	13	—½	6 3 1
do. do. 6 per cent. Pref.	6	6	10½	—	5 18 5
County of London	7	7	11¾	—	6 5 7
do. do. 6 per cent. Pref.	6	6	10½	—	5 18 5
Kensington Ordinary	6	7	5½	—	5 19 2
London Electric	Nil	Nil	1½	—	Nil
do. do. 6 per cent. Pref.	4	5	4	—	6 5 0
Metropolitan	3	4	3½	—	6 3 1
do. 4½ per cent. Pref.	4½	4½	3½	—	6 18 6
St. James' and Pall Mall	8	9	7½	—	6 6 4
South London	5	5	3	—	6 13 4
South Metropolitan Pref.	7	7	20/6	—	6 16 7
Westminster Ordinary	7	9	7½	—	6 6 4
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	99	—	6 1 0
do. Def.	1½	1½	23½	—	6 9 6
Chile Telephone	8	8	7½	—	5 6 8
Cuba Sub. Ord.	7	7	10½	—	*6 13 4
Eastern Extension	8	8	15½	— ½	*5 3 3
Eastern Tel. Ord.	8	8	157½	—2	*5 1 7
Globe Tel. and T. Ord.	7	7	14¼xd	—	*4 16 5
do. do. Pref.	6	6	10¼xd	—	5 14 3
Great Northern Tel.	24	22	33½	+ ½	6 11 5
Indo-European	13	13	58½	—	6 11 0
Marconi	15	20	4½	—	4 6 7
Oriental Telephone Ord.	10	10	8½	—	2 17 2
United R. Plate Tel.	8	8	7½	—	*5 3 3
West India and Panama	6d.	1/3	1½	—	*3 12 6
Western Telegraph	8	8	16½xd	—7/-	*4 18 7
Home Rails.					
Central London Ord. Assented	4	4	65½	—	6 2 2
Metropolitan	—	1	30½	— ½	3 5 6
do. District	Nil	Nil	26	+ ½	Nil
Underground Electric Ordinary	Nil	Nil	3¾	— ¼	Nil
do. do. "A"	Nil	Nil	9/-	—	Nil
do. do. Income	6	4	91	— ½	*4 8 0
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	42	—	6 6 4
Anglo-Arg. Trams. First Pref.	5½	5½	44	—	—
do. do. 2nd Pref.	5½	—	3½	—	—
do. do. 5 Deb.	5	5	75½	—	6 12 5
Brazil Tractions	—	—	56	—	—
Bombay Electric Pref.	6	6	102	—	5 11 7
British Columbia Elec. Rly. Pfds.	5	5	67½	—	7 11 5
do. do. Preferred	Nil	Nil	52½	—	Nil
do. do. Deferred	Nil	Nil	46½	—1	Nil
do. do. Deb.	4½	4½	62	—	6 17 8
Mexico Trams 5 per cent. Bonds	Nil	Nil	67	—	Nil
do. 6 per cent. Bonds	Nil	Nil	56	+1	Nil
Mexican Light Common	Nil	Nil	38xd	—2	Nil
do. Pref.	Nil	Nil	49	—1	Nil
do. 1st Bonds	Nil	Nil	71	—	—
Manufacturing Companies.					
Babcock & Wilcox	15	15	97	—1½	4 0 0
British Aluminium Ord.	10	10	31½	+1/9	5 3 1
British Insulated Ord.	20	20	2½	—	4 9 0
British Westinghouse Pref.	7½	7½	2½	—	5 14 1
Callenders	20	25	10½	+ ½	6 2 0
do. 5 Pref.	5	5	5½	+ ¼	5 0 0
Castner-Kellner	22	20	8½	—7/16	5 10 4
Edison-Swan, "A"	—	—	—	+7/16	Nil
do. do. 4 per cent. Deb.	4	4	75½	—	5 6 0
Electric Construction	7½	10	1½	—	6 0 0
Gen. Elec. Pref.	6	6	10½	—	6 2 4
do. Ord.	10	10	17½	—	*5 12 8
Henley	20	25	2½	—	5 11 4
do. 4½ Pref.	4½	4½	4	—	6 12 6
India-Rubber	10	10	17½	—	*5 12 8
Telegraph Con.	20	20	48	—	*5 0 0

*Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, December 18th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/5	1d. dec.
a Ammoniac Sal	per ton	£80	£20 dec.
a Ammonia, Muriate (large crystal)	"	£77	..
a Bisulphide of Carbon	"	..	..
a Borax	"	£43	..
a Copper Sulphate	"	£60	..
a Potash, Chlorate	per lb.	2/1	3d. dec.
a " Perchlorate	"	1/9	3d. dec.
a Shellac	per cwt.	£17 10/-	..
a Sulphate of Magnesia	per ton	£15	..
a Sulphur, Sublimed Flowers	"	£94	..
a " Lump	"	£26	..
a Soda, Chlorate	per lb.	1/1	..
a " Crystals	per ton	170/-	..
a Sodium Bichromate, casks	per lb.	..	..
METALS, &c.			
c Brass (rolled metal 3" to 12" basis)	per lb.	..	..
c " Tubes (solid drawn)	"	..	..
c " Wire, basis	"	..	..
c Copper Tubes (solid drawn)	"	1/7½	¾ to 1¼ dec.
g " Bars (best selected)	per ton	£150	£11 dec.
g " Sheet	"	£150	
g " Rod	"	£150	
d " (Electrolytic) Bars	"	£145	£12 dec.
d " " Sheets	"	£161	..
d " " Wire Rods	"	£136	£12 dec.
d " " H.C. Wire	per lb.	1/4	1½d. dec.
f Ebonite Rod	"	2/-	..
f " Sheet	"	2/6	..
a German Silver Wire	"	2/6	..
h Gutta-percha, fine	"	11/-	..
h India-rubber, Para fine	"	2/8	2d. dec.
i Iron Pig (Cleveland warrants)	per ton	Nom.	..
l " Wire, galv. No. 8, P.O. qual.	"	£37	..
g Lead, English Pig	"	..	..
g Mercury	per bot.	Nom.	..
e Mica (in original cases) small	per lb.	9d. to 4/6	..
e " " " medium	"	5/- to 10/-	..
e " " " large	"	12/6 to 25/- & up.	..
d Silicium Bronze Wire	per lb.	1/8	2½d. dec.
r Steel, Magnet, in bars	per ton	..	..
g Tin, Block (English)	"	..	..
n " Wire, Nos. 1 to 16	per lb.	4/6	6d. dec.

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Still & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

American Emergency Acts Abandoned.—The Priorities Commissioner of the War Industries Board announces that the Board has rescinded the entire "preference list." This means that the classification of the industries as essential or less essential has been abandoned, and that the Government will not longer direct the distribution of materials and facilities to industries engaged particularly in war work. Meanwhile, to aid reconstruction, preference in the allocation of materials and facilities will be granted to public utilities and to enterprises of greatest civilian importance.

The so-called War Emergency Power Act, under which Congress was to have appropriated $200,000,000 for assisting in the supply of power by privately owned companies will be abandoned.

The U.S. Fuel Administrator has given notice that the rules and regulations and the supervision of the fuel administration now in force will continue until the promulgation of the treaty of peace.

Electricity in Agriculture.—M. T. Lecler presented a report to the French Civil Engineering Congress on the means that should be adopted to extend the use of electricity for agricultural purposes. According to an abstract of the report in the *Revue Générale de l'Electricité* of September 28th, petrol-driven tractors have been tried and found to give unsatisfactory results in unskilled hands. The electric motor has many advantages in its reliability, simplicity, ease of operation, and low first cost and maintenance. Furthermore, an electric supply may be used for purposes of electroculture. The report suggests the appointment of a committee of experts to supervise the improvement of agricultural electrical apparatus, to guide research on its use, and to administer Government funds for these purposes. It then investigates the power required to operate various agricultural devices. An obstacle to the development of electricity for agriculture is presented by the low consumption usually required for a given area. This amounts generally to about 20 KW.-hours per hectare per annum. The consumption could, however, be increased to at least five times this amount by an extension of the uses to which the electric supply is put. At this figure it would become profitable to the supplier. Common action should be taken by agricultural workers, suppliers of electrical energy and manufacturers of the appliances.

THE SUPPLY OF SINGLE-PHASE POWER FROM THREE-PHASE SYSTEMS.

By PROF. MILES WALKER, D.Sc., M.I.E.E.

(Abstract of paper read before the Institution of Electrical Engineers.)

(Concluded from page 587.)

From the power company's point of view, the inductance is not an unmixed blessing. By reducing the power factor it calls for more copper in the mains for a given load, and reduces the output of the generators. Sudden heavy calls for low-power-factor current have a bad effect upon the regulation of the whole system. But so greatly does the stability given by the inductance help towards economy in furnace linings, that large numbers of furnaces in this country and in America are run at 0.7 power factor. The single-phase furnace, having only one carbon at the top, presents a smaller area of roof lining to the fierce radiation from the arc, and for this and other reasons set out above it is more economical than the three-phase furnace.

It will be seen, then, that in designing a balancer to provide a single-phase furnace load from three-phase power mains it is desirable that the single-phase winding should have such a high inductance that the current will lag 45 deg. at full load. At the same time, it is desirable that the three-phase winding should be operated at unity power factor. These conditions can be met by building a three-phase synchronous motor having an ordinary three-phase armature winding lying in slots near the working face of the stator (see fig. 7), and provided with a single-phase winding lying in slots further removed from the rotor than the three-phase slots and arranged so that very considerable magnetic leakage occurs between the two windings at full load.

The dimensions of the three-phase slots near the surface of the armature and of the single-phase slot lying in the centre of the punching are shown in fig. 8. This figure also shows a narrow slot 0.45 cm. wide, across which the leakage flux finds its way at full load. The machine described is one of two designed for the Snyder Electric Furnace Co., and now in successful operation in this country. Another, somewhat similar, machine has been designed to be built by the Allis-Chalmers Co., of America, and several machines of larger output are in contemplation. The British machines are required for furnaces to make steel for war purposes.

In the case of the 400-kw. balancer here described, the following were the particulars of the conditions to be met:—

Three-phase supply. Line voltage	6,000 at 50 cycles.
Input to furnace	350 to 400 kw.
Voltage on arc and connecting cables in phase with the current	156.
Effective inductive drop in furnace and cables	25 to 50 volts.
Single-phase voltage at terminals of balancer	160.
Inductive drop in windings of balancer ...	110 to 130.
No-load voltage...	220 to 247, say 234.
Single-phase amperes	2,400 to 2,700.
Temperature rise of balancer after full load for three hours	45° C.

One of the special features of this type of balancer is a compensating winding designed to inject a boosting voltage into the two phases of the three-phase winding that lie adjacent to the single-phase winding, in order to prevent those windings from taking more than their share of the load. If this winding were not provided, phases A and C

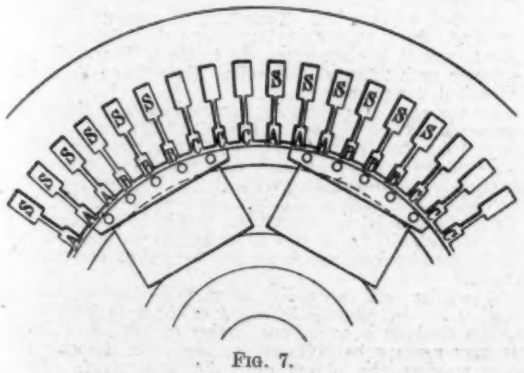

Fig. 7.

(adjacent to which the single-phase slots are placed) would take a load equivalent to a single-phase load on the three-phase system by reason of the fact that the magnetic coupling between these phases and the single-phase coils is more complete that the coupling between the single-phase winding and phase B. Another way of looking at the matter is this: When current passes through the single-phase winding, it drives magnetic flux* across the three-phase slots of phases A and C and causes an inductive drop in these phases; so that there will flow from the line a current of such value and of such phase that it produces an impedance rise sufficient to balance the inductive drop produced by the single-phase magnetomotive force. Since the resistance drop is small, compared with the reactive drop, the excess current that would be taken by phases A and C would be almost in exact opposition of phase to the single-phase current.

One way of preventing this action is to inject into phases A and C an electromotive force which shall at all times be exactly equal and opposite to the electromotive force generated in the three-phase winding by the interlinked flux from the single-phase magnetomotive force. The most direct way of doing this is to wind a few turns of wire interlinked with the main leakage path of the single-phase winding, and electrically connect these to phases A and C so that the E.M.F. generated in the turns by the main leakage shall oppose the E.M.F. generated in the three-phase winding by the small leakage across the three-phase slots. As the leakage flux

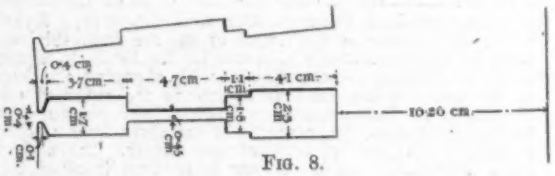

Fig. 8.

across the leakage air-gap is great, compared with the leakage across the three-phase slots, only very few turns of compensating winding are required to balance the E.M.F. in the 16 conductors per slot of the three-phase winding. The counter magnetomotive force set up by these few turns is so small, compared with the magnetomotive force of the single-phase winding, that it can be neglected in roughly estimating the number of compensating turns required. The manner of winding and connecting the compensating conductors can be seen from figs. 9 and 10.

In order to provide a means of making small adjustments in the balance of the load on three-phase winding after the machine was built, three tappings were taken off each of the phases near the star point. The tappings give a choice of cutting out 1.56 per cent., 3.12 per cent., or 4.68 per cent. of the phase voltage. In practice it was found that the connection that gave the best result with only three compensating turns connected was that shown in fig. 11. The effect of this slight dissymmetry in the connections was to give a slight dissymmetry at no load; this dissymmetry is of no importance in practice, and can be eliminated in future by a better adjustment of the compensating winding. When there is no load on the single-phase winding, there is no E.M.F. in the compensating winding;† and as it is the same magnetomotive force that operates upon the compensating winding as operates upon the three-phase winding and creates a tendency to unequal back E.M.F., the right adjustment of the compensating winding should bring about a nearly exact balance of the phases. The currents in the

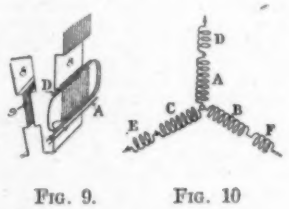

Fig. 9.

Fig. 10

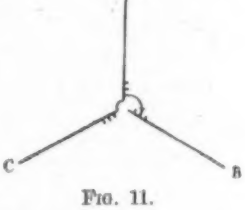

Fig. 11.

damper on the field poles also tend to create a disturbance in the balance of the load; this disturbance is of a very complex nature, but is not of very great moment.

The damper consists of 9 drawn-copper bars of taper section, held in dovetail slots in the pole face, and pinned and sweated to a copper casting encircling each pole. The copper castings are bolted together from pole to pole so as to form a complete squirrel-cage winding. In order to avoid any inductive action between the individual stator slots and the bars of the damper, the slots on the field poles are skewed through a complete stator slot pitch. With this arrangement the damper showed no signs of heating at no load, and only very slight heating at full load.

Apart from the special features above mentioned, the design of the balancer follows very closely the design of an alternating-current generator or synchronous motor.

An allowance of 8 kw. has been made for extraneous loss

* It should be noted that any change which occurs in the field flux due to the single-phase load (except in so far as it is exterior to the damper) affects phase B as much as phases A and C.

† Except a very small inductive drop due to the three-phase load, which can be compensated for by the addition of a small choke coil in phase B.

at full load, bringing up the total losses at full load to 42.4 KW. Thus the efficiency works out at 90.4 per cent.

A full-load test was made after the machine had been delivered to the works of Messrs. Summerson, Ltd., Darlington. Characteristic figures of the test are given. When running light there is a dissymmetry in the power taken by different phases, due to the arrangement of taps shown in fig. 11, but does not cause any measurable interference with the voltage at the end of a long feeder. When the furnace is in circuit, the amount of load can be varied slightly by altering the distance between the electrodes. The point

TESTS ON SITE.

Speed.	Exciting amps.	Three-phase side. Volts.	Amperes. A	B	C	KW. A-B	C-B	Single-phase side. Volts.	Amps.	KW.	Remarks.
750	29	6,100	3·2	3·4	2·4	9	14	224	0	0	Running light.
750	39	5,960	45	45	49	200	232	1·6	2,450	190	Full load.
750	39	5,980	13	13	18	38	83	Not readable	3,520	75	Carbon short-circuited.

of maximum load is in practice found by trial. Any increase or decrease of the length of the arc from this maximum-load point causes a decrease in the load. It is sometimes convenient to vary the load by changing the length of the arc, but the steadiest conditions are obtained when the arc is on the maximum-load point. The balance of the load is quite good, the currents in the three lines A, B, and C being 45, 45, and 49 amperes respectively. The deviation from the perfect balance is not more than is often found on standard polyphase machines.

A very interesting experiment is to screw down the top carbon until it dips into the metal in the furnace. As the arc is shortened, the voltage falls; when the carbon is in contact with the metal the voltage cannot be read on the voltmeter, and the watts fall to a small amount of the order of 75 KW., depending upon the condition of the charge. The current rises to somewhere between 3,500 and 3,800 amperes. The load on the three-phase side falls to about 121 KW. This is satisfactory from the power company's point of view.

In ten appendices full details are given of the calculations involved in the design of the machine, and various propositions referred to in the paper.

REGULATIONS FOR ARC WELDING.

By H. M. SAYERS, M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

ELECTRIC arc welding shows promise of extensive developments. The practice at present is maily empirical. In view of the possibilities of its application to shipbuilding, one of the Admiralty Departments has set up an Electric Welding Research Committee, including a number of unofficial members representing important interests who offered to render voluntary assistance in the development of electric welding.

One of the points which has come before the Committee is the question of regulations in respect of (*a*) safety of operators, (*b*) conditions of supply; and it has been thought essential to have a discussion in order to get the views of members of the Institution on these matters.

The Home Office at present has made no regulations, but is keeping an eye on the processes, and wishes to obtain the views of the industry. The Board of Trade has no regulations specifically dealing with welding, but it is clear that some modifications and additions to the existing regulations may be required. In both cases it is desirable that there may be no regulations issued which may be found to hamper progress.

A very large and influential Research Committee has been formed in the United States.* It is communicating all its proceedings and reports to the Admiralty Committee, and among them the discussions and reports on regulations.

The Admiralty Committee has already drawn up a skeleton form of regulations based on experience in this country and the communications from the United States.

This paper is therefore brought forward to introduce a discussion, and to set out the points as they at present appear to arise in practice.

Necessary regulations are conveniently divided into two heads:—

1. Regulations affecting the safety of operators and workers in their vicinity.

2. Regulations affecting the reliability and regulations of general supply systems.

Taking the first heading, there are two main points:—(*a*) Protection of operators and neighbouring workers from the effect of the radiations from the arc; (*b*) protection from shock.

(*a*) *Protection from Radiation.*—It is well known that the light from a naked arc has a serious effect upon the eyes and the skin. This is more serious with the iron arc than with the carbon, as the iron-arc radiation is richer in rays of short wave-length, including ultra-violet rays, which are specially detrimental. Welding arcs require large currents, *e.g.*, a No. 10 welding rod requires up to 120 amperes, and as the extension of the arc to heavier work is clearly foreshadowed, arcs carrying several hundred amperes have to be reckoned with in considering protective appliances.

Where welding is carried out in a factory under stationary conditions the provision of screens, masks, &c., for the welders can be readily arranged, and each operator's position can be isolated from neighbouring workers by suitable screens.

More difficulty arises in such work as welding the hulls of ships, where the welders must work on stages; and most, perhaps, in repair work.

The object to be attained in every case is that arc radiations shall not reach the eyes or skin of either the operators or persons in the vicinity, except through screens which obstruct the injurious rays.

The welder himself and any assistant must be able to see his work, and it is therefore necessary that such screens as they use shall be reasonably transparent to ordinary light. It has to be remembered that the skin of the hands, arms, face, and neck needs protection. This can be given by any opaque material. Glass can be obtained which is practically opaque to the most injurious rays, and yet fairly transparent to ordinary light. Combinations of coloured glasses are also in use, which are fairly satisfactory. The U.S. Research Committee has recommended certain combinations of this kind.

It is clearly important that the screen or mask used shall be such as not to restrict the operator's movements or to cause discomfort. Goggles protect the eyes only. Masks, which protect the face as well, are open to objection on the point of comfort. A screen held in the left hand carrying a sufficient area of suitable glass, and an apron to shield the left arm, are satisfactory for stationary work. It may not prove so good for shipbuilding and repair work, where the left hand may be required for other uses.

There is a danger radius from an arc of given power, beyond which no screening is necessary. But intense lights within the usual field of vision are objectionable, quite apart from directly injurious effects, so that screening seems desirable in any case. In shipbuilding it is probable that whilst welding is in progress on any section all the near-by workers will be welders, and their mates who will have their individual protection.

In repair work, especially in ship spaces, exigencies of time may require other workers to be employed close to the welders, and perhaps the only possible regulation would have to be in the general terms that efficient shielding from the arc must be employed in such cases.

It may be said that whilst the short-length waves are responsible for the damage to the eyes and the skin, the long-wave or heat radiations also produce sunburn effects on the skin, which must be guarded against. This effect is, however, essentially of short range, and mainly affects the welders themselves.

(*b*) *Protection from Shock.*—The pressure across a welding arc is quite low. Both for direct and alternating-current arcs it is of the order of 25 to 30 volts. But there is always a steadying resistance or choker in series, and when the arc is broken there is the full supply pressure on the electrode. It is at this time that there is more danger of shock, both because of the higher pressure and because the electrode is not visibly dangerous. It may be inadvertently touched.

It has to be remembered that in working from a stage, &c., the danger of shock is from indirect effects such as those causing a start or stumble, or loss of balance. With D.C. arcs there need be no danger if the supply conditions are properly adjusted; 100 volts is the maximum supply pressure necessary either for carbon or for metallic electrodes, including steadying resistances, and 100 volts D.C. will not make a man start or stumble. Therefore, as regards direct-current welding, the maximum voltage needed is below the danger point, and it is only necessary to limit the supply pressure to some such figure as 100 volts. Even 200 volts can hardly be called dangerous.

In the case of alternating-current welding the conditions are rather different; whilst the actual arc voltage as shown by a voltmeter is quite low, 30/35 volts, practice shows that a considerably greater circuit voltage must be available. This matter is under special investigation. It must meanwhile be accepted that at least 65 volts is needed for A.C. welding. This pressure is capable under certain conditions of giving a severe shock. A welder is certain to have his skin damp with perspiration, which is one condition favourable to a shock.

A welder will normally wear a protecting gauntlet of leather, so that there is little risk of shock through the hands unless working in conditions leading to wetting of the gloves. It may perhaps be necessary to lay down the rule that for A.C. welding the gloves must be waterproof. The most likely chance of getting shocks seems to be when the electrode is laid aside and the welder has his hands bare. It is suggested that this danger can be averted by a "no current" circuit breaker in the circuit, which could be cut out by a pedal switch for the purpose of restarting the arc. This "no current" breaker would serve another useful purpose in preventing the use of too long an arc, which makes bad work.

* ELEC. REV., December 6th, 1918, p. 555.

It is submitted that both for A.C. and D.C. welding the work should always be earthed, or connected to the earthed pole of the supply circuit.

It should be a rule that a proper hook or receptacle should be always provided for an electrode not in actual use, and should always be used. Possibly this rule might dispense with the "no current" breaker in A.C. work. The flexible lead to the electrode must necessarily be somewhat heavy in copper section. The insulating covering must be strong and flexible. Armouring is scarcely admissible on account of weight and stiffness. It should be readily detached from the connecting socket, for ease of exchange, and there should be a switch or breaker between the supply and socket.

The insulation of the flexible near the electrode holder is exposed to considerable heat, conducted and radiated. It must not be damaged by this heating.

The steadying resistances require just the same precautions as resistances for arc lamps, but as the currents are heavy and pass during the whole of the welding operation ventilation must be good. The resistances, chokers, &c., must be capable of carrying the short-circuit current without rising to a dangerous or destructive temperature. The same regulations as for other similar operations should suffice.

Supply Regulations.—The conditions of welding are not favourable for direct supply from the mains of a supply undertaking. The maximum voltage needed is considerably below most supplies. The condition that the work must be earthed is also objectionable from the point of view of a supply authority. A higher supply voltage may be used by using a larger resistance in the welding circuit, but this is wasteful, and increases shock dangers. It is not likely to be used where welding is in constant or frequent use.

Where the general supply from the mains is direct-current the pressure will be 200 volts or over from each outer to earth. This is much higher than needed, and it brings in a distinct danger of shock, besides being wasteful of energy. It can be excluded from consideration for equipment in steady use. It will pay the user to put in a converting set yielding the desired voltage.

The case of occasional welding may need consideration. It may pay the user to throw away 75 per cent. of the energy in resistance rather than incur the cost of a converting set. In such cases the safety arrangements must be similar to those provided for A.C. sets. The supply interests, it may be suggested, will be sufficiently protected by providing that the current taken shall be limited in the same way as to any other power circuit. It seems obvious that welding supply-circuits must be run separately from any others from the consumer's main fuses. It should be arranged that the work connection can only be made to the earthed lead of the supply. But it must be expected that the work will be earthed in many cases, and it is suggested that supply engineers should tolerate this with such reservations as to power to disconnect for testing purposes, &c., as they think necessary to protect their systems. The Board of Trade regulations will need an exception to be made in the same sense.

Where, as in most cases, motor-generators are used for supplying D.C. welding sets, the supply mains have better protection. Where single welding units are installed, some such device as the "Daysohms" magnetic clutch* between the motor and generator is an added protection to the plant.

Alternating-current Welding.—Owing to the cheapness and efficiency of transformers, they will always be used between the mains and the welding circuit. From safety considerations alone these should be of the two-circuit type and have earth shields.

Where single-phase is given, the supply undertaking hardly needs special protection, excepting those common to other power uses. It may perhaps be thought advisable to require that part of the resistance in the electrode circuit shall be in the form of choking coils to limit the current on striking the arc, and on making accidental contacts.

Where the supply is given from a multi-phase system, questions of balancing arise. The simplest connection is to put the welding transformer across one phase. If a number of welders are in use and they are equally divided between the phases, they will approximately balance each other.

A single-phase supply can be obtained from either two-phase or three-phase systems, loading each phasing. With two-phase three-wire distribution a single-phase supply can be obtained from the two outers, giving 1.414 times the voltage of either phase. This can be transformed in a single-phase transformer to the welding pressure. Whilst this connection loads each phase equally as regards current, the resultant current is out of phase, lagging on one side and leading on the other, reducing the power factor and tending to unbalance the voltage on the two phases.

Alternatively single-phase current can be taken from each phase directly, and where a number of welders are in use this is the simplest and most satisfactory connection, the welders being equally divided between the phases. There is the probability that unequal numbers will be in simultaneous use on the two phases, producing some unbalanced load.

With three-phase distribution single-phase current can be taken from a three-phase transformer with its secondaries connected in a particular way. This connection gives currents largely out of phase in opposite senses in two of the windings, tending to unbalance the voltage and reducing the power factor.

Welders can obviously be fed from the separate phases, and if a fair number are distributed between the phases the resulting out-of-balance loads will be only those due to differences in the numbers in simultaneous use.

The whole question from the supply point of view is one of magnitude of the effect, having regard to the relative proportions of the welding load and the general load supplied by the power or sub-station affected. The provision of condensers or other corrective devices on the lagging-current phase may be worth while in large lay-outs. (Here the author drew attention to Prof. Miles Walker's paper; see p. 585 of our last issue.)

At the present stage it seems premature to make definite regulations. Supply undertakers would be sufficiently protected by the provision that for welding plant above a certain capacity, varying with local conditions, the method of converting the supply shall be subject to their approval, which shall not be unreasonably withheld.

In both D.C. and A.C. welding the striking of the arc is potentially the short-circuiting of the leads. It is on a par with the starting up of a motor, but somewhat more favourable, inasmuch as when welding there must be a resistance in circuit, and the current can be limited by providing some minimum resistance or choker which the operator's regulating switch does not cut out. Similar regulations to those limiting starting currents on motors will therefore suffice, with the simplification that where a number of welders are in use a single limiting device in the mains is all that is necessary to protect the supply.

*Elec. Rev., January 25th, 1918, p. 94.

Discussion.

Mr. C. H. Wordingham, in calling upon Major Caldwell to open the discussion, explained the object of the paper, which was to obtain the views of the industry on the question of protection, and to afford an opportunity for members of the Institution to express an opinion as to the formulation of regulations for the protection of welders and other workers in the vicinity during welding operations.

Major James Caldwell, R.E., gave an indication of the position of electric welding development in the United States of America. He said that last year investigations were carried out by the Standards Committee of the A.I.E.E. in order to standardise spot welders and the apparatus connected therewith.* That Committee was later transferred to the General Engineering Committee of the Council of National Defence, formed to deal with engineering aspects for war preparation. Part of its activity was devoted to considering the possibilities of electric spot-welding, and also the successful production of cast-steel anchor chains, which last spring obtained the approval of the classification societies under test specifications 40 per cent. more severe than those for wrought-iron chain.† The first order—a trial order—for cast-steel chain saved the U.S. Shipping Board £10,000.

Whilst attending meetings of the Standards Committees in London in November, last year, the American representative, Mr. H. M. Hobart, interested himself in electric welding development here, and submitted a full report on the subject to the U.S. authorities. Subsequently, on the invitation of the U.S. Shipping Board, he (Major Caldwell) was privileged to visit America to explain the procedure adopted by the Admiralty relative to the application and use of electric welding at factories and in the dockyards where the arc process had been applied successfully.

He stated that Prof. Comfort A. Adams, at that time president-elect of the Institute, was granted four months' leave of absence from his work at Harvard University and the Massachusetts Institute of Technology, in order that he might devote himself entirely to electric welding investigations. Furthermore, a regular session of the Mid-Winter Convention of the A.I.E.E. had been assigned to electric welding. Meantime the Council of National Defence had abolished its Advisory Committees, but within a fortnight of his (Major Caldwell's) arrival in New York the Emergency Fleet Corporation of the U.S. Shipping Board decided to adopt the Electric Welding Committee as formerly constituted, including representatives covering broadly the whole field of welding activities in America.

Along with Prof. Adams, Mr. Hobart, and one or other of the Committee, he visited as many shipyards as it was possible to include in the itinerary of the trip, and attended meetings of shipbuilders and local representatives of the Emergency Fleet Corporation and the classification societies held at New York, Boston, Philadelphia, and Baltimore. On all such occasions it was explained how the demand for oxy-acetylene welding gases had so enormously increased in this country during the war that electric arc welding was taken up as a substitute, with the result that it was found in many cases superior to the former method.

He cited many applications of electric welding at munitions factories, shipyards, and naval dockyards in this country, followed by a description of the cross-channel barge which was then in course of construction entirely by means of electric welding.‡ He also assisted in the early work of the Electric Welding Committee, which proceeded to collect data and suggestions as to the methods of applying electric

* Elec. Rev., December 6th and 13th, 1918.
† Elec. Rev., August 2nd, 1918.
‡ Elec. Rev., August 9th, 1918.

welding with the intention of ascertaining the best processes, standardising the apparatus, and considering how welding should be used to advantage in ship construction and repair. In that way much useful work had been accomplished and important facts established.

As regarded the extent to which electric welding had been utilised in the several services in America, the resistance system, including butt, spot, and line welding had already been used to a much more considerable degree than in this country, even for heavy parts. Interesting operations were viewed by him at the Schenectady works of the General Electric Co., where three-ply, of 1-in. steel plates were satisfactorily welded together, and again at the Metropolitan Engineering Works, Brookland, N.Y., where shells, 9½ in. diameter, were formed in two parts out of 2-in. steel plate blanked in presses, with the longitudinal seam butt-welded in one operation. The electric welding machines used at the latter works were of special interest, as the necessary pressure was effected with electromagnets, and although an accurate estimate of the maximum current could not be ascertained, the circuit-breaker at each machine was set for 15,000 KW.

It was noted that considerable use of arc welding by means of bare and gaseous flux-covered metal electrodes was limited to railroad shops and the manufacture of transformer tanks, besides the usual repair services. Arc welding by means of carbon electrodes was employed for minor structural work at some of the earlier shipyards, but the liquid flux-covered electrode as manufactured by the Quasi-Arc Weltrode Co. in America was not at the time of his visit appreciated to the extent it deserved; in fact, the method of applying that process did not appear to be understood by the firms who had installed equipments. The bare-metal system of arc welding had achieved much success in America, particularly in the railroad shops, where a high degree of proficiency prevailed. There were, however, certain conditions which seemed to preclude the universal adoption of any one of those methods, dependent upon the conditions of electricity supply, the equipment available, and the strains to which the welded part would be exposed whilst in service.

To attain satisfactory results with electric arc welding, it was his opinion that current regulation provided by specially-constructed machines was of almost negligible importance as compared with: Skill of the operator; choice of proper electrodes for the work in hand; current adjustment to suit the size and type of electrode employed.

Both in this country and America there had been an utter absence of any agreement as to the electrode material and the voltage conditions for obtaining the best results. He maintained that there was no notable difference in the mechanical characteristics of welds made with direct current and alternating current, although certain electrodes were much more suitable for direct-current work, whilst others gave undoubtedly better results when used with alternating current. The quality of welding work performed by alternating current was of the highest grade, and, moreover, some American authorities maintained that there were certain characteristics of the alternating-current arc which made it more difficult to do poor work than in the case of direct current.

The quantity of current employed in making the weld was of great importance. Considerable skill was required to secure a satisfactory weld with current of sufficient amount to permit penetration and fusion at the welded joint. Improved results were attained with increased current when the speed of working was greater, although more expert manipulation was required on the part of the operator.

Lower current densities were preferable with flux-covered than with bare-metal electrodes, although it was a matter for consideration whether the present figure of from 4,000 up to 6,000 amps. per sq. in. should not be considerably increased, in view of the satisfactory results obtained in America with bare-metal electrodes designed for 6,000 to 14,000 amps. per sq. in. There was a definite current at which most efficient welding could be achieved on any work. That current was determined by the heat conductive capacity of the work being welded, and was the current at which, with the operator working at his maximum speed, the metal in proximity to the arc was pre-heated to very nearly the correct fusion temperature. Below that current the operator would have to reduce his speed to get proper penetration of the deposited metal, and above it he was wasting energy heating up the work, and would run risks of burning holes right through the metal. Heat dissipating qualities were proportionate to the thickness of plate; therefore, the thicker the plate the higher the current that could be employed.

In putting forward recommendations relating to the most suitable voltage for use at the arc, Mr. H. M. Sayers had raised a point on which there were still many divergent views. One argument in favour of limiting the available voltage was to compel the operator to use more care in keeping the arc short and of nearly constant length, which was a fundamental requirement for a good weld. But he had seen good results obtained with both 40, 110, and intermediate voltages, in the same way as with the usual positive and negative connections reversed.

In the old days it was thought that anyone would serve as an electrician, and now it appeared to be the belief that any unskilled labourer would pass as an efficient welding operator. On the contrary, electric welding was a craft requiring skill which was not always obtained after long practice, although with extended training some men and women became so proficient that they were able to do the most difficult work within three months. That point should be appreciated, particularly where other than repetition work was being done. Those who had been responsible for welding undertakings realised how much successful results depended on the operator who was entrusted with the work.

Prof. C. R. DARLING suggested that the Committee should endeavour to secure uniformity as regards welding operations; there should be some definition laid down as to what constituted a good or a bad weld. It was also desirable that there should be more uniformity as to the fluxes, current, and voltage that should be used. In America spot-welding had furnished some very good results; it was not understood in this country to the same extent as it was over there, and there was still much pioneer work to be done here.

Mr. G. SCOTT RAM said that it would be extremely difficult to limit the voltage as a means of protection against shock, because no two persons were alike as to the voltage they could stand without dangerous results. He had made some experiments himself on these lines, and he had found that even with only 40 volts it was not possible to let go once contact had been made. The electrode handle was a source of danger. He had seen such handles in use to which brass ferrules and set-screws were attached; that was obviously dangerous. It would be said that the operator always wore gloves, but why should gloves be necessary if the holder was properly designed? He maintained that danger could be limited to the electrode holder as other parts could be earthed, and especially the object that was being welded should always be earthed. He had once investigated the death of a boy who had come in contact with a tank that was being welded. The tank was not earthed, and when the boy made contact he was quite unable to let go again, with fatal results, and yet the voltage between the tank and earth was only 60 volts. He thought face protection, while necessary, was a disadvantage, because the operator was not able to see properly what he was doing.

Dr. W. ROSENHAIN said that electric welding was a growing industry, and regulations were undoubtedly necessary. Regulations should be framed not only as to how to weld, but also as to what to weld and what not to weld. Referring to Mr. Sayers's suggestion that stained gelatine films could be used in place of glass as a protection for the eyes, he thought that such films would not be found practicable, because they would have a very short life; they would deteriorate very quickly. During the last 10 years or so much research work had been carried out, and glass possessing good absorptive properties was now obtainable. Sir Wm. Crookes had done some important research work in connection with glass, and there was a considerable range of glass now available that would absorb both red and ultra-violet light. In connection with protective goggles or masks, he suggested that two sheets of glass should be used, the outer sheet to dilute, and the inner one, next to the eyes, to absorb.

Prof. E. W. MARCHANT said that the question of eye protection was a difficult one, because the eyes of no two persons were alike. As an illustration, he mentioned that most people would be temporarily blinded if they looked at a bare arc even for a very short space of time, whereas he himself could look at an arc for as long as one minute without any ill-effects whatever. The same argument applied to the question of shock. He had once made some experiments on some of his students, and he found one man—a black man—upon whom an electric shock had no effect whatever. Referring to tests he had carried out with a motor-generator for electric welding, he said he had been extremely interested to watch the metal at the point of welding. The process was almost exactly similar to that of bricklaying. He also exhibited lantern slides of current and voltage curves showing the rise in pressure when the arc was broken, and the effect of putting reactance in the circuit.

Mr. W. STEEL did not think that glass was a suitable eye protection; its disadvantage lay in the fact that the operator could not see through it sufficiently clearly. He suggested the use of a V-shaped screen made up of strips of different glass, so that the operator could look through either strip as desired. It was desirable that the welder should always have one hand free, and therefore any protective device should be so designed that it was not necessary for the operator to hold it in his hand. It was necessary to have one hand free so that the operator might be able to steady himself, especially when standing on a staging. He further called attention to the defective methods of attaching leads to the electrode holder; such leads should have a long enough life to make it worth while soldering them to the holder.

Mr. A. HENDERSON agreed with the remarks made by the previous speaker; it was important to protect the eyes of not only the welder, but also workmen in the vicinity. He did not think that alternating current was suitable for use on ship work because of the difficulty of guarding against shock, especially as most workmen engaged on such work stood upon staging, and there was danger of a fall following the shock. He thought that direct current was more suitable for overhead work on ships.

Mr. T. A. SEDGWICK said that his firm were prepared to spend £20,000 to make a good start on electric welding. They had committed themselves to a pressure of 60 volts with reactance in series, but they would welcome all and

any information that could be given on the subject. At Barrow they had succeeded in welding brass to steel quite satisfactorily, also watertight joints could be made very much more easily by means of welding. Certain jobs which formerly took 10 minutes to do were now being done in one, or even one-half a minute by welding.

Mr. A. COLLIE preferred the use of direct current; he thought that dangerous results from a shock at 100 volts were quite out of the question. The shielding of adjacent workmen was very important, but he doubted whether a screen could be devised that would fit into all the cramped positions on a ship where a welder was required to work.

Mr. SWIFT described the E. and E. magnetic arc system of electric welding; he showed lantern slides of the "Daysohms" patent automatic magnetic clutch,* and explained the advantages to be derived by the use of the same.

Mr. MARKHAM thought that no hard and fast rules or regulations could be made. He did not think the real danger had anything to do with electric shock; it was more likely to result from the surprise at receiving a shock which would cause the operator to fall. The real difficulty lay in shielding workmen in the vicinity as a welder who understood what he was doing would also realise the danger, and would take necessary precautions. He suggested the use of reactance to keep down peaks and to steady the arc.

Another speaker took strong exception to the remarks made by the last speaker. In his experience he had found that the British workman required to be watched and nursed like a child. He did not trouble himself in the least about taking precautionary measures against any form of danger; on the other hand, he lost no time in claiming compensation when any accident did occur. Most firms insured their welders, and if they did not draw up some sort of protective regulations the insurance companies would very soon compel them to do so.

The AUTHOR, in reply to some of the points raised, said that it was most important to shield onlookers and adjacent workmen, as it was quite possible for such persons to receive serious injury without their being aware of it. It was possible, but he did not think probable, that fatal results would follow a shock of 100 volts; however, all regulations were framed to protect the weakest, and not the strongest. Referring to the use of gelatine films, his suggestion was that they should be protected with glass, and not used alone. He did not think that the short life of such films would prevent their being used, as they could very easily be renewed. He said it was not possible to procure glass through which the welder could see clearly and which at the same time would afford sufficient protection. With regard to the best colour of protective glass, in his opinion an apple green was the most effective for the human eye.

ELECTRICITY SUPPLY PROGRESS IN WAR TIME.

(*Continued from page* 585.)

SWINDON.

During 1916 the Corporation of Swindon (Mr. F. Newey, acting borough electrical engineer) installed one 300-KW. and one 500-KW. rotary converter, together with suitable switchgear, and high-pressure mains—overhead and underground—to supply a Government factory in the neighbourhood. Early this year it was found that there would be large additional requirements of power at the factory, and it was decided early in January that if the Corporation could have a new turbine running at the works by the end of April, additional plant would be installed. The Corporation agreed to get the work executed by the time mentioned. Accordingly about the third week in January the work of dismantling one of the reciprocating sets was begun, and new foundations for a turbine were prepared. The new plant installed this year consists of two 1,000-KW. Ljungström turbines, and three 12,000-lb. Babcock boilers, together with coal-handling plant, economisers, feed pumps, &c.; an additional 0.2 sq. in. high-pressure main was also laid to the factory, where transformers and additional switchgear were installed. The total rated output of the generating plant has thus been raised from 1,400 KW. to 3,400 KW.

WOKING.

Prior to the war practically all the energy sold by the Woking Electric Supply Co., Ltd. (Mr. F. Woods, resident engineer) was for lighting purposes, but soon after hostilities began munition works commenced to appear for the making of aeroplanes and engines, and practically the whole of these factories have taken their supply from the company, whose output rapidly advanced until nearly 75 per cent. consisted of power units. These are being supplied to very important works on the mains, which cover an extremely wide area, and take in many villages and small towns.

To meet the load it was necessary to install a new turbine, so one of the Brush Co.'s Ljungström type of 1,000-KW. capacity was added. The plant capacity was thus raised from 1,100 to 2,100 KW. Several large mains extensions were made, and the company supplies power to all classes of aeroplane manufacture, including the planes, engines, and the Admiralty Park where the completed machines are tested, passed, and sent abroad. Other classes of consumers include Army and Navy barracks, sponge and timber factories, &c.

IPSWICH.

At the outbreak of hostilities the undertaking of the Corporation (Mr. F. Ayton, chief engineer and manager) was arranged for the generation of direct-current supply only. Orders had, however, been placed prior to the war for plant for a three-phase high-pressure supply at 3,300 volts and 50 periods, including a rotary-converter sub-station containing two 250-KW. rotary converters with their transformers. Duplicate feeders were laid to this sub-station, and thence to a couple of static transformer sub-stations, which fed a low-pressure 4-wire 3-phase network. A total of 5.45 miles of low-pressure 4-core main has been laid.

The supply was commenced by transforming from D.C. through the medium of a 312-K.V.A. rotary converter and transformer working inverted. As a stand-by, the 220-KW. D.C. generator was removed from one of the Reavell engines, the engine was altered to give the required frequency, and a Westinghouse alternator of 240 K.V.A. was fitted. The whole of the rotary-converter plant was supplied by the British Westinghouse Co.

The power station high-pressure switchboard and the sub-station switchgear had been ordered before the war broke out from the firm of Voight & Haeffner (England), Ltd. This firm was subsequently taken over by the Switchgear Construction Co., who completed the contract.

The high- and low-pressure three-phase cables were ordered before the war from the Ateliers de Constructions Electriques du Nord & de l'Est. They were manufactured at their Jeumont (France) works, and the first batch of cables was got away safely. This place, however, being close to Mons, and on the borders of Belgium, was shortly after the outbreak of war taken possession of by the Germans, and the last heard of the second batch of cables intended for Ipswich was that the drums containing them were being used for barricading roads by the German army. The cables needed for completing the scheme were obtained from Messrs. Johnson & Phillips, Ltd.

The three-phase supply was commenced at the end of March, 1915, and very shortly after Messrs. Ransomes, Sims and Jefferies began taking a supply they found it necessary to apply for a much greater amount of power. Consequently a 500-KW. rotary converter and transformer were ordered from the British Thomson-Houston Co. for the sub-station, and a 500-KW. rotary converter and transformer, arranged to run inverted, from the General Electric Co. for the power station. The switchgear was provided by the British Thomson-Houston Co. This additional plant has been running fully loaded for the last 18 months of the war.

The power station was soon taxed to its utmost. The total available capacity for meeting the outside demand was about 3,300 KW. Last winter the maximum demand was well over 2,800 KW. Considerable trouble has, however, been experienced with the plant due to frequent breakdowns of turbines and their dynamos, and the failure of the reciprocating plant, due to wear and tear and the impossibility of executing repairs by the time needed. This undertaking has also suffered each winter from shortage of boiler power and the deterioration in the quality of the coal. In November, 1917, a new boiler with a normal rating of 18,000 lb. of steam per hour was ordered from Messrs. Babcock & Wilcox; this boiler, which was promised for completion by the end of July, was only got into commission the last week in November. Owing to the overloaded condition of the plant, the five dry-back marine-type boilers have not been properly cleaned and overhauled for over a year, while the large marine-type Babcock boiler has not been properly cleaned and overhauled since Easter. The consequence is that efficiency has seriously fallen off, and the staff has had a most anxious time. While the output of the power station for the year ending March 31st, 1914, was 2,829,000 units sold, that for the year ending March 31st last was no less than 6,797,400 units.

The Corporation has placed orders for extension plant totalling £43,000, the scheme including the installation of a 3,750-K.V.A., Brush-Ljungström, three-phase turbo-alternator. An order has also been placed with the British Thomson-Houston Co. for a 1,500-KW. rotary converter to work inverted and provided with an automatic control induction regulator. The British Thomson-Houston Co. has also received the order for the extension to the power station switchgear. The installation of the new turbine plant necessitates an extensive scheme of new circulating water supply and discharge pipes. Provision is also being made for eventually dealing with three turbine sets, each having an output of 3,750 K.V.A. A vertical-spindle turbine type pump driven by a 120-B.H.P. Laurence, Scott motor has been ordered from Messrs. Gwynnes, Ltd., and a rotating disk screening gear from Messrs. F. W. Brackett & Co., of Colchester.

TWICKENHAM AND TEDDINGTON.

Prior to the war the Twickenham and Teddington Electric Supply Co. (Mr. M. Farrer, engineer and manager) gave a D.C. supply only, with the exception of a small three-phase lighting load in one or two outlying districts. The plant

* ELEC. REV., January 25th, 1918.

capacity was then 1,180 KW. in reciprocating sets. During the war the company installed two 100-KW. turbines, and is now completing a further 2,000-KW. turbine extension. Some 24,000 yds. of H.T. and E.H.T. mains have been laid to supply the new factories which have sprung up in the district, and which include a shell factory taking a maximum of 900 KW. and an aircraft factory taking a maximum of 300 KW. The supply given before the war to the National Physical Laboratory has also been greatly extended.

A special feature at Twickenham has been the number of small factories and workshops started in any sort of building which could be found, and employing from 16 to 20 men. Most of these small firms are Belgian.

The company's output has increased very largely; in 1913 2¼ million units were generated, which increased in 1917 to 8 million units.

It is difficult at present to estimate the future prospects. The use of electricity for power purposes has been given an impetus during the war, which is bound to have a permanent effect; on the other hand, the war industries are shutting down, and it remains to be seen whether a residential district with few industrial advantages will be able to obtain a share of the engineering work of the future in competition with the recognised industrial areas. Up to last spring the heating load was developing satisfactorily, but for the time being it has been crippled by the Household Fuel and Lighting Order.

STOCKPORT.

The Corporation of Stockport (Mr. R. Lomax, borough and tramway electrical engineer) inaugurated its A.C. supply in 1913, when the first 2,000-KW. turbine was installed. A second 2,000-KW. turbine was installed in 1914, and one of 5,000 KW. in 1916. An additional 5,000-KW. turbine is now about to be delivered. This should have been installed 12 to 18 months ago. Also two additional boilers were installed in 1914, two more in 1915, and a fifth in 1917. The annual output has risen as follows:—

Year ended March 31st,	1913	... ...	6,241,063 units.
,, ,,	1914	... ...	7,493,204 units.
,, ,,	1915	... ...	9,179,595 units.
,, ,,	1916	... ...	15,134,461 units.
,, ,,	1917	... ...	20,002,963 units.
,, ,,	1918	... ...	24,500,598 units.

Applications for textile industries have been refused to the extent of 6,000 to 7,000 KW., and owing to the lateness of delivery of boilers and generating plant on order supplies have had to be considerably curtailed to less important industries than those engaged on work of the highest national importance.

(To be continued.)

NEW PATENTS APPLIED FOR, 1918.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEPTON-JONES, O'DELL AND STEPHENS (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C.1.

19,844. "Device for electrical illumination for theatrical effect, &c." T. H. ROCHFORD. December 2nd.

19,846. "Lamp locking nut." F. W. GARDINER. December 2nd.

19,853. "Electric cookers." G. WILKINSON. December 2nd.

19,873. "Electrical apparatus." C. H. PLYTON. December 2nd.

19,877. "Telegraph pole mortising and boring machines." E. TUCKETT. December 2nd.

19,896. "Method of selecting and intensifying sound waves." L. BARLOW. December 2nd.

19,906. "Control of electric supply plant." W. J. BRANSOM & H. J. READ. December 2nd.

19,913. "Electrical control apparatus." A. J. ROBERTS. December 2nd.

19,955. "Electrical equipment of motor vehicles, boats, &c." W. A. COCKING & W. E. HEAN. December 3rd.

19,957. "Sparking plugs for internal-combustion engines." B. CARTER, J. SUCKLING & W. SUCKLING. December 3rd.

19,995. "Electro-vaporisers and heaters." ELECTRIC STEAM RADIATOR CO. December 3rd. (U.S.A., November 30th, 1917.)

20,004. "Wireless receiving gear." BRITISH THOMSON-HOUSTON CO. AND R. C. CLINKER. December 3rd.

20,027. "Dynamo-electric machinery." V. MALLALIEU. December 4th.

20,044. "Washer for sparking plugs, &c." J. E. BARROWS. December 4th.

20,068. "Overhead electric trolleys." J. FORD & E. H. JACKSON. December 4th.

20,069. "Sparking plugs." A. E. LAMKIN. December 4th.

20,090. "Continuous feed for arc lamps." A. D. STANDEFORD. December 4th.

20,109. "Electric relays." G. MCALPINE. December 4th.

20,110. "Electromagnet wave signalling systems." J. ERSKINE-MURRAY. December 4th.

20,122. "Electromagnetic measuring instruments." F. J. GREEN. December 5th.

20,131. "Sparking plugs." W. H. HARRIS. December 5th.

20,135. "Means for obviating risks due to failure of insulated joints, &c." A. R. ANGUS. December 5th. (Sweden, December 5th, 1917.)

20,168. "Electromagnetic apparatus." E. S. CAREY. December 5th.

20,170. "Automatic switches, circuit systems, and operating methods." D. S. HULFISH. December 5th. (U.S.A., December 8th, 1917.)

20,177. "Brakes for electrically-propelled vehicles." P. A. H. MOSSAY. December 5th.

20,178. "Electrically-propelled trucks, tractors, &c." P. A. H. MOSSAY. December 5th.

20,184. "Screw-nut for securing shade, &c., on electric lamp fitting." L. G. FLOAT. December 5th.

20,187. "Appliance for progressive heating of liquid by electric resistance." H. WITTLE. December 5th.

20,189. "Ignition systems for internal-combustion engines." A. H. MIDDLEY & C. A. VANDERVELL & Co. December 5th.

20,209. "Lamp telephone relays." M. LATOUR. December 5th. (France, December 5th, 1917.)

20,220. "Electric motor controllers." W. ROGERS. December 6th.

20,235. "Giving constant number of revolutions to a dynamo for giving steady electric light on vehicles." N. OLECHNOVITCH. December 6th.

20,241. "Metal work for assembling and fixing conduits of non-circular section in electrical installations." L. JOUBERT. December 6th.

20,254. "Manufacture of electric dynamos and motors." T. L. R. COOPER, A. LYON & WRENCH, AND J. C. TODMAN. December 6th.

20,255. "Electric apparatus." A. LYON & WRENCH & A. WILLMOTT. December 6th.

20,258. "Electric magnetic apparatus for protecting pneumatic tires." G. ODIERNO. December 6th.

20,266. "Thermostatic circuit-controlling devices." AMERICAN FIRE PREVENTION BUREAU INC. December 6th. (U.S.A., February 8th.)

20,267. "Ignition systems." DAYTON ENGINEERING LABORATORIES CO. December 6th. (U.S.A., December 15th, 1917.)

20,279. "Circuit arrangement for reduction of static interference in radio-receiving stations." WESTERN ELECTRIC CO. (Western Electric Co., U.S.A.) December 6th.

20,285. "Means for supporting overhead conductors on railways, tramways, &c." E. H. WHITTALL. December 6th.

20,289. "Electric switches." C. A. W. HULTMAN. December 6th. (Sweden, December 11th, 1917.)

20,312. "Locking out disengaged levels on electrical signalling systems." M. O. MYERS & R. C. ROBSON. December 7th.

20,330. "Electrical ceiling roses, &c." W. HOLT. December 7th.

20,335. "Turbine electric driving-gear." F. FOSTER. December 7th.

20,374. "Apparatus for hardening and tempering metal wire by electricity." A. IMBERY. December 7th.

20,375. "Electric muffle furnaces." A. IMBERY. December 7th.

20,378. "Electric metallurgical furnaces." W. E. MOORE. December 7th.

20,379. "Armatures and pole shoes of magnets." L. DE M. G. FERREIRA. December 7th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1917.

14,561. MAGNET COIL WINDINGS, SPECIALLY APPLICABLE TO FIELD COIL WINDINGS FOR DYNAMO-ELECTRIC MACHINES, TRANSFORMERS, AND THE LIKE. Lancashire Dynamo & Motor Co. and H. B. Whitmore. October 8th, 1917. (120,593.)

15,076. ELECTRODES OF SECONDARY BATTERIES. E. F. Ablitt, B. de Q. Quincey & A. J. Adams. October 17th, 1917. (120,598.)

16,238. ELECTRIC FUSES. V. Hope. November 7th, 1917. (120,600.)

16,317. MEANS FOR CONTROLLING THE ELECTRIC LIGHTING OF MOTOR VEHICLES. W. Curtis. November 8th, 1917. (120,602.)

16,361. SUPPORTS FOR TELEPHONE RECEIVERS. M. Weil. November 8th, 1917. (120,436.)

16,394. GALVANIC BATTERIES. G. Oldham & J. Oldham. November 8th, 1917. (120,439.)

16,425. RAILWAY SIGNALLING AND HIGH-FREQUENCY SELECTIVE DEVICES FOR USE IN CONNECTION THEREWITH. McKenzie, Holland & Westinghouse Power Signal Co. (Union Switch & Signal Co., U.S.A.) November 9th, 1917. (120,441.)

16,434. COOLING ARRANGEMENTS FOR DYNAMO-ELECTRIC MACHINERY. Lo-Thermo Patents, Ltd., B. Longbottom & E. Greenhalgh. November 9th, 1917. (120,605.)

16,507. ELECTRIC FURNACE. C. H. von Baur. November 10th, 1917. (120,444.)

16,645. ELECTROLYTIC GAS GENERATORS. I. H. Levin. November 13th, 1916. (111,483.)

16,763. MAGNETIC APPARATUS FOR INDICATING VERTICALITY AND ORIENTATION IN INCLINED BODIES SUBJECTED TO CENTRIFUGAL FORCE. J. T. Clarke. November 15th, 1917. (Cognate application 7,244/18.) (120,625.)

17,014. CONSTRUCTION OF ELECTRIC COLLECTORS. Soc. Anon. des Etablissements L. Bleriot. November 20th, 1916. (111,847.)

17,364. ELECTRIC SWITCHES. G. Tua. November 24th, 1916. (111,851.)

17,450. ELECTRIC SWITCHES. G. Tua. April 4th, 1917. (Addition to 17,364/17.) (114,615.)

17,470. ENGINE STARTERS. V. Bendix. November 26th, 1917. (120,465.)

17,690. ELECTRICALLY-OPERATED RIVETING, PRESSING, STAMPING, AND THE LIKE MACHINES. E. Adamson. November 30th, 1917. (120,651.)

17,775. ROTORS FOR DYNAMO-ELECTRIC MACHINES. Vickers, Ltd., & S. F. Barclay. November 30th, 1917. (120,653.)

19,063. SPRING TERMINALS FOR ELECTRIC ACCUMULATORS. Fuller Accumulator Co. & A. P. Welch. December 24th, 1917. (120,479.)

1918.

480. TELEPHONE SYSTEMS. Automatic Telephone Manufacturing Co. (Automatic Electric Co. U.S.A.) January 8th, 1918. (120,483.)

600. MANUFACTURE OF ELECTRIC CABLES. C. J. Beaver & E. A. Claremont. January 10th, 1918. (Addition to 4,808/17.) (120,485.)

1,804. SPARKING PLUGS FOR IGNITION PURPOSES. A. E. Heath. January 31st, 1918. (120,492.)

2,089. SYSTEMS OF ELECTRICAL DISTRIBUTION. British Thomson-Houston Co. (General Electric Co., U.S.A.) February 5th, 1918. (120,677.)

2,164. CONTROLLERS FOR ELECTRIC MOTORS. J. C. Kelso. February 6th, 1918. (120,495.)

2,208. REMOVABLE ELECTRICAL FUSE-CARRIERS OR CONNECTING DEVICES. British Insulated & Helsby Cables and L. B. Wilson. February 7th, 1918. (120,678.)

2,384. ELECTRIC CELLS. C. Fery. February 9th 1918. (120,681.)

3,340. ELECTRIC CELLS AND BATTERIES. R. S. Baxter. March 5th, 1918. (120,689.)

4,120. HEATING CONDUCTORS OF THERMIC TELEPHONES. P. de Lange and Naamlooze Vennootschap de Nederlandsche Thermo-Telephoon Maatschappij. March 8th, 1918. (Patent of addition not granted.) (120,507.)

8,084. SPARKING PLUGS. J. M. E. Franc. May 14th 1918. (120,519.)

8,242. PROTECTION MEANS FOR TERMINALS OF ELECTRIC BATTERIES. A. H. Sheppard & British Ever-Ready Co. May 16th, 1918. (120,521.)

Electric Welding on Concrete Ships.—Electric welding has recently been introduced in British concrete ship-yards with satisfactory results for connecting various members of the reinforcement as an alternative to the use of wire ties. The welds are very quickly made and hold the bars so firmly in their final positions that the blocks, wedges and distance pieces otherwise necessary can be entirely eliminated.—*Steamship.*